MINERAL CHARACTERIZATION AND CATALOGING OF QUARRIED AGGREGATE SOURCES USED IN MICHIGAN HIGHWAY CONSTRUCTION

Volume II: Materials Characterization Database

Submitted to the

Michigan Department of Transportation

By

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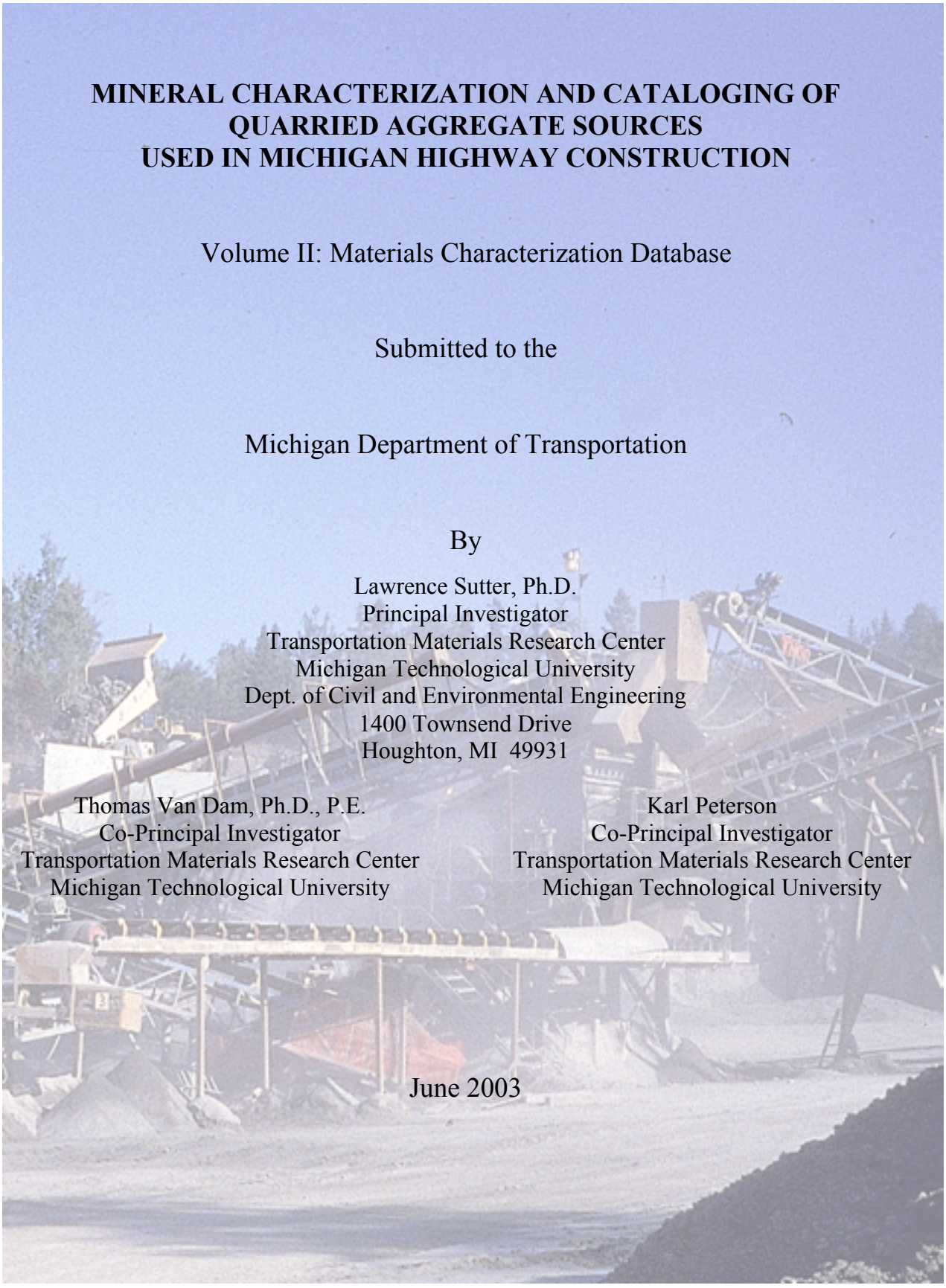

June 2003

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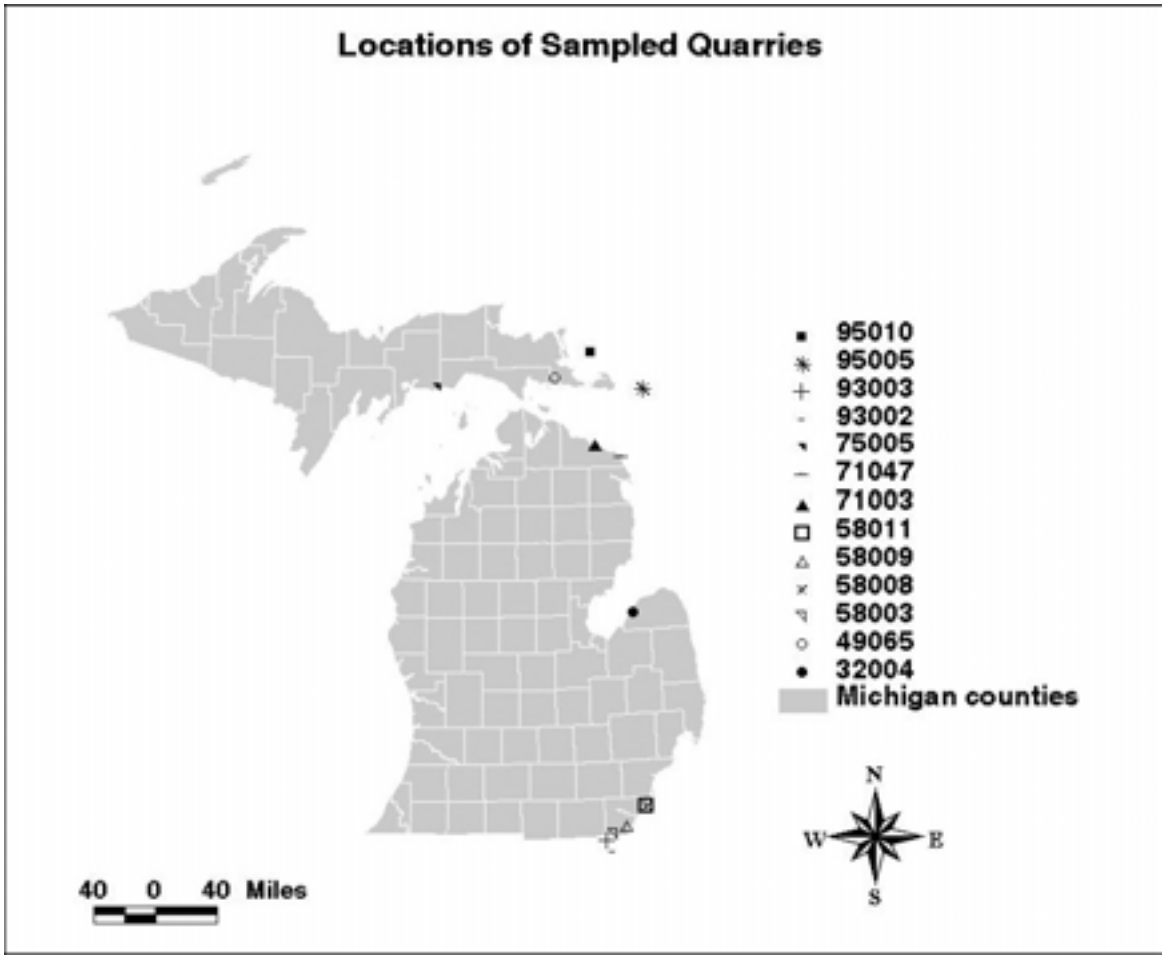
PREFACE

The methods used to collect the data presented here are outlined in Volume I - *Mineral Characterization and Cataloging of Quarried Aggregate Sources Used in Michigan Highway Construction*.

MAP OF SAMPLED QUARRIES



32004 - Wallace

Table 1-1: Pit name, location, and general geologic information:

Pit Number	32004
Name	Wallace
Longitude	-83.33
Latitude	43.84
Era	Palaeozoic
Period	Devonian
Group	
Member	Bayport Limestone
Rock Type	sandy dolomitic limestone
Description	Tan to gray, sandy with abundant fossils in a matrix of fine grained dolomitic limestone.

Table 1-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	5.931E-06
Bulk specific gravity (oven dry)	2.61
Bulk specific gravity (saturated surface dry)	2.64
Apparent specific gravity	2.71
Absorption %	1.37
Average grain intercept length (µm)	17.1
Area % micro-pores	6.08
Average micro-pore diameter (µm)	1.64

Figure 1-1: Photo of 3/8" sieve fraction of 6AA product.

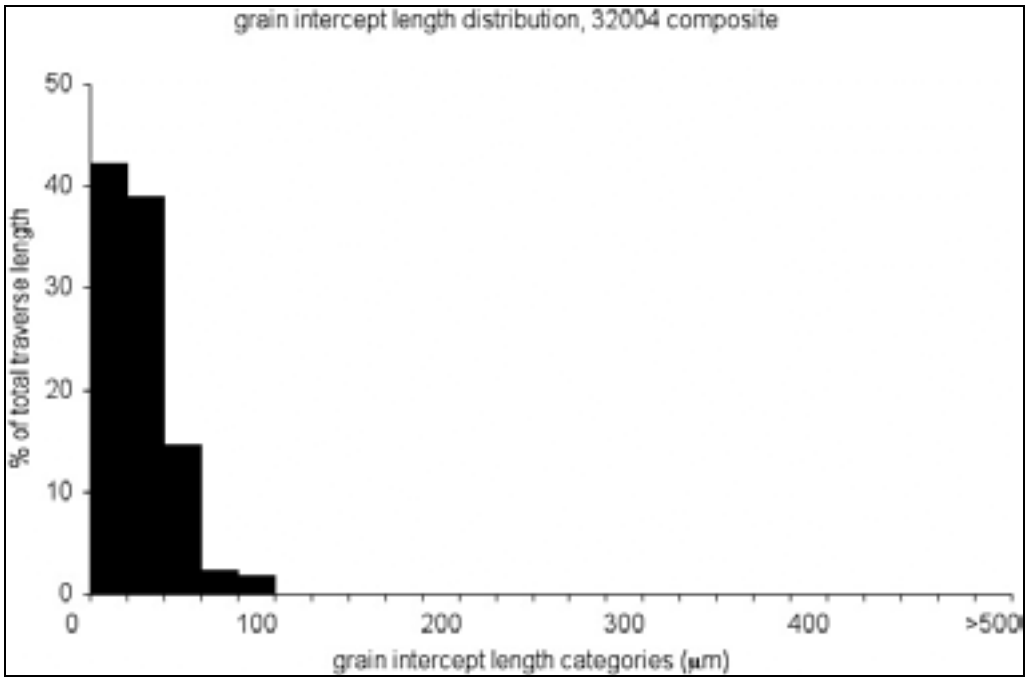


Figure 1-2: Grain intercept length distribution from petrographic microscope traverse.

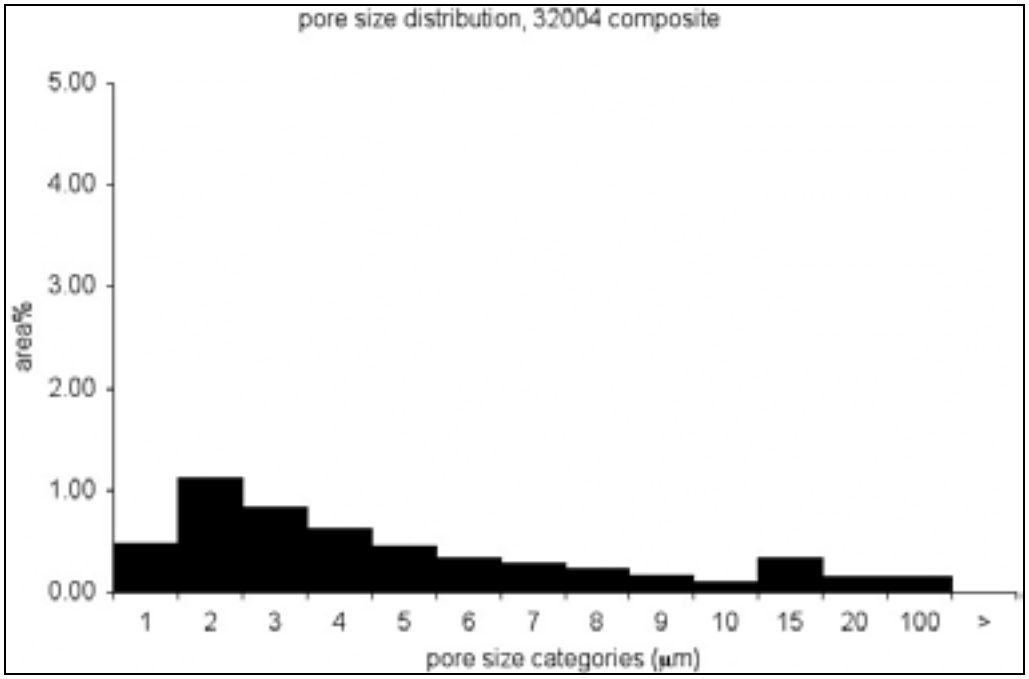


Figure 1-3: Micro-pore size distribution from back-scattered electron images.

Table 1-3: Data for grain intercept length distribution plot shown in Figure 1-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	42.24	42.24
20 to <40	38.99	81.22
40 to <60	14.62	95.85
60 to <80	2.28	98.12
80 to <100	1.88	100.00
100 to <120	0.00	100.00
120 to <140	0.00	100.00
140 to <160	0.00	100.00
160 to <180	0.00	100.00
180 to <200	0.00	100.00
200 to <220	0.00	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 1-4: Data for micro-pore size distribution plot shown in Figure 1-3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.48	9.08
1 to <2	1.11	30.25
2 to <3	0.83	46.10
3 to <4	0.62	57.78
4 to <5	0.46	66.43
5 to <6	0.33	72.63
6 to <7	0.28	77.99
7 to <8	0.23	82.40
8 to <9	0.17	85.69
9 to <10	0.11	87.84
10 to <15	0.33	94.16
15 to <20	0.16	97.11
20 to <100	0.15	100.00
100 and >	0.00	100.00
sum	5.27	

Table 1-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	1.38
Al_2O_3	0.79
SiO_2	12.71
S	0.10
CaO	44.56
Fe_2O_3	1.17
sum	60.72

Table 1-6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	6.33
Calcite - $CaCO_3$	76.09
Pyrite - FeS_2	0.18
Other	12.71
sum	95.31

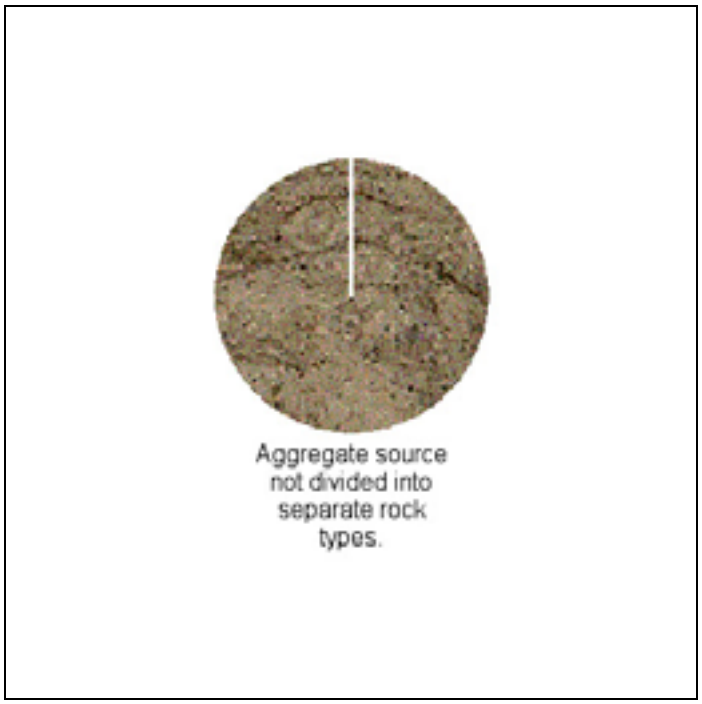


Figure 1-4: Rock types within aggregate source based on differences in color and texture.

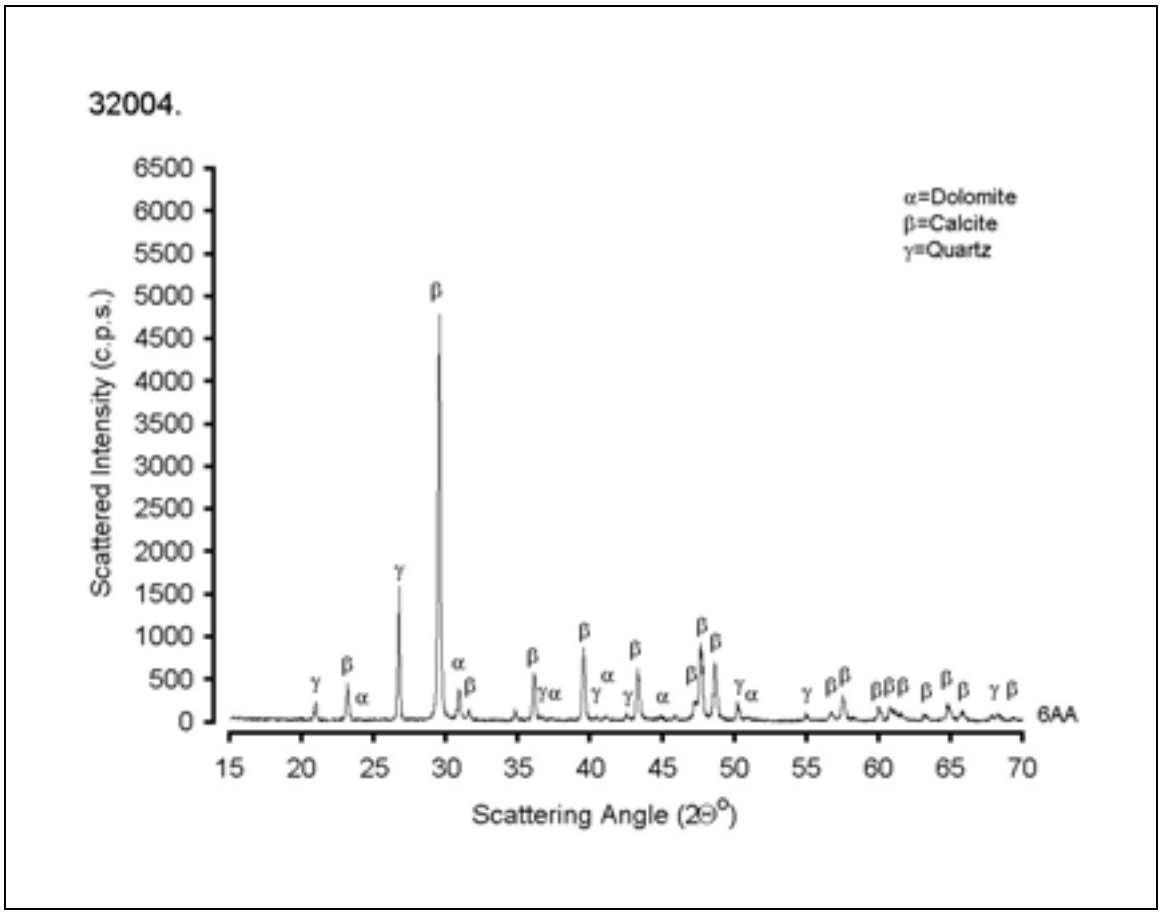


Figure 1-5: X-ray diffraction pattern from aggregate source.

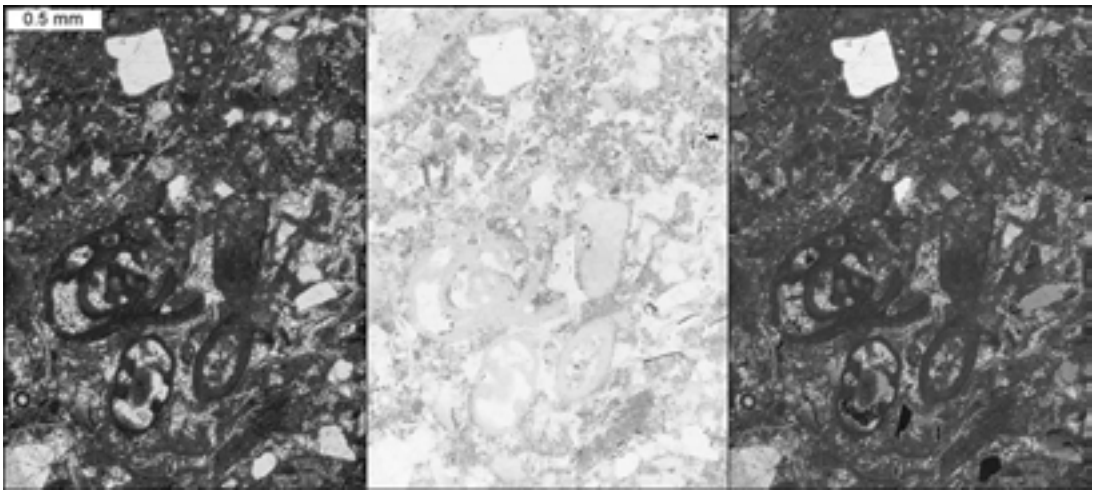


Figure 1-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

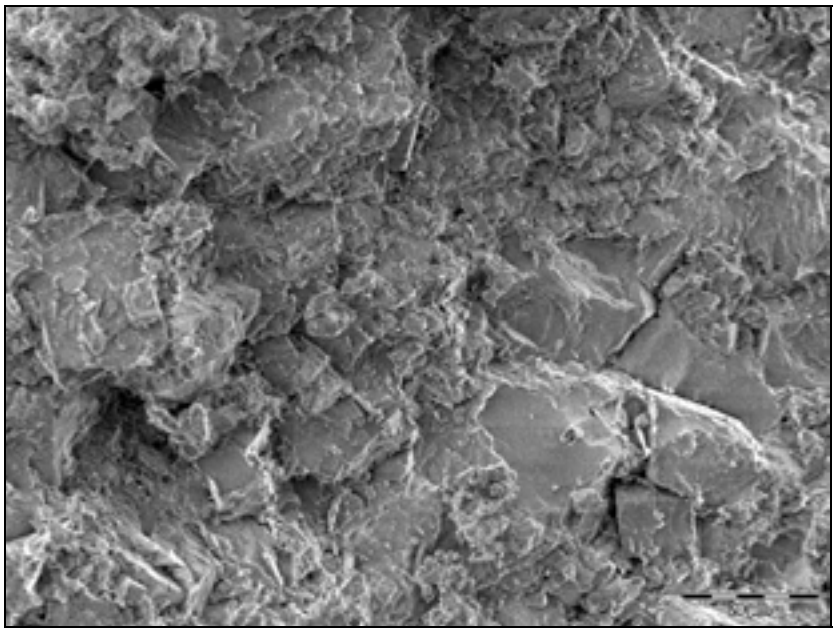


Figure 1-7a: ESEM photo of fracture surface.

Table 1-7: Grain intercept length statistics:

Grain intercept length (μm)	
Average	17.1
Median	13.6
Standard deviation	12.7
Maximum	94.9
Minimum	2.8

Table 1-8: Micro-pore diameter statistics:

Micro-pore diameter (μm)	
Average	1.64
Median	1.12
Standard deviation	1.65
Maximum	48.57
Minimum	0.60

49065 - Cedarville

Table 2-1: Pit name, location, and general geologic information:

Pit Number	49065
Name	Cedarville
Longitude	-84.29
Latitude	46.05
Era	Palaeozoic
Period	Silurian
Group	Engadine
Member	
Rock Type	dolomite
Description	Light tan to gray to dark gray medium to coarse grained dolomite.

Table 2-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	7.843E-06
Bulk specific gravity (oven dry)	2.79
Bulk specific gravity (saturated surface dry)	2.80
Apparent specific gravity	2.82
Absorption %	0.48
Average grain intercept length (µm)	137.7
Area % micro-pores	5.45
Average micro-pore diameter (µm)	1.57

Figure 2-1: Photo of 3/8" sieve fraction of 6AA product.

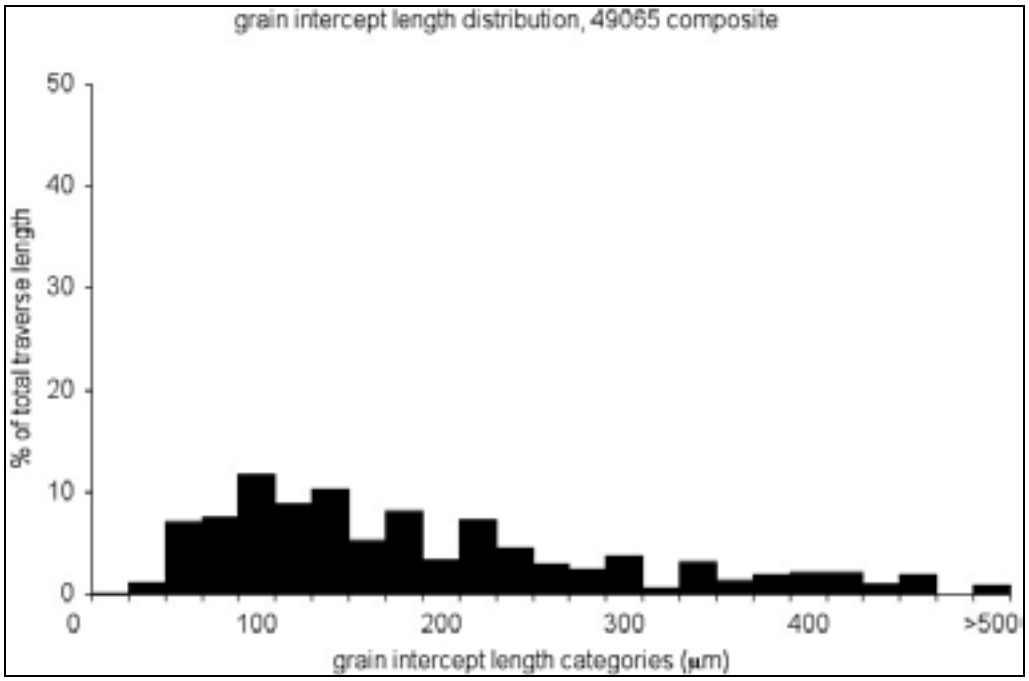


Figure 2-2: Grain intercept length distribution from petrographic microscope traverse.

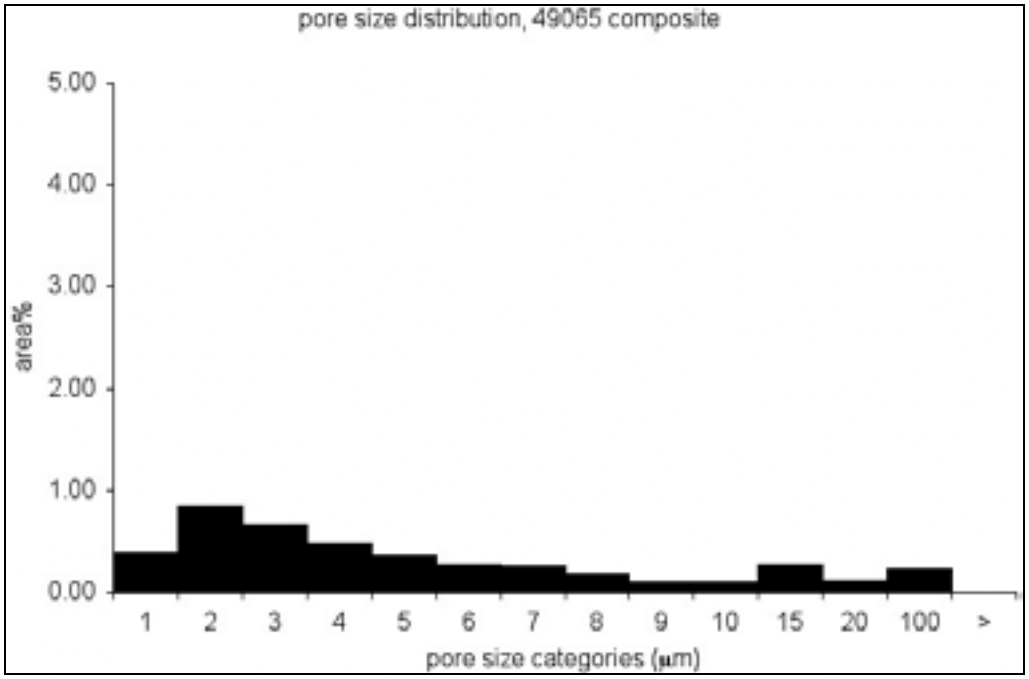


Figure 2-3: Micro-pore size distribution from back-scattered electron images.

Table 2-3: Data for grain intercept length distribution plot shown in Figure 2-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	0.14	0.14
20 to <40	1.23	1.36
40 to <60	7.04	8.40
60 to <80	7.52	15.92
80 to <100	11.73	27.66
100 to <120	8.89	36.55
120 to <140	10.31	46.86
140 to <160	5.30	52.16
160 to <180	8.14	60.30
180 to <200	3.36	63.66
200 to <220	7.19	70.85
220 to <240	4.59	75.45
240 to <280	3.10	78.54
280 to <300	2.46	81.00
300 to <320	3.84	84.84
320 to <340	0.56	85.40
340 to <360	3.22	88.62
360 to <380	1.35	89.98
380 to <400	1.90	91.87
400 to <420	2.16	94.03
420 to <440	2.14	96.17
440 to <460	0.99	97.15
460 to <480	1.90	99.05
480 to <500	0.04	99.09
500 and >	0.91	100.00

Table 2-4: Data for micro-pore size distribution plot shown in Figure 2-3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.39	9.09
1 to <2	0.85	28.87
2 to <3	0.66	44.29
3 to <4	0.48	55.58
4 to <5	0.36	64.09
5 to <6	0.27	70.32
6 to <7	0.26	76.29
7 to <8	0.18	80.41
8 to <9	0.11	82.94
9 to <10	0.11	85.43
10 to <15	0.26	91.61
15 to <20	0.13	94.57
20 to <100	0.23	100.00
100 and >	0.00	100.00
sum	4.28	

Table 2-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	21.45
Al_2O_3	0.16
SiO_2	0.91
S	0.02
CaO	30.11
Fe_2O_3	0.19
sum	52.86

Table 2-6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	98.14
Calcite - $CaCO_3$	0.48
Pyrite - FeS_2	0.04
Other	0.91
sum	99.57

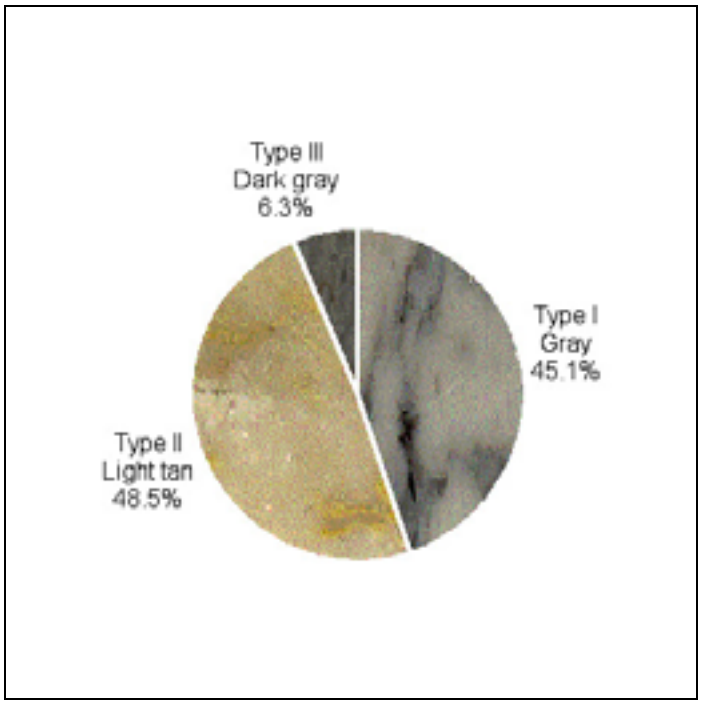


Figure 2-4: Rock types within aggregate source based on differences in color and texture.

Table 2-7: Composition as determined by x-ray fluorescence, by type:

Oxide/element wt%	I	II	III
MgO	21.46	21.39	21.47
Al_2O_3	0.16	0.21	0.17
SiO_2	0.98	1.18	1.17
S	0.01	0.01	0.02
CaO	30.19	30.05	30.00
Fe_2O_3	0.19	0.21	0.22
sum	52.98	53.05	53.05

Table 2-8: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral wt%	I	II	III
Dolomite - $Ca,Mg(CO_3)_2$	98.17	97.85	98.25
Calcite - $CaCO_3$	0.59	0.52	0.22
Pyrite - FeS_2	0.02	0.02	0.04
Other	0.98	1.18	1.17
sum	99.75	99.57	99.67

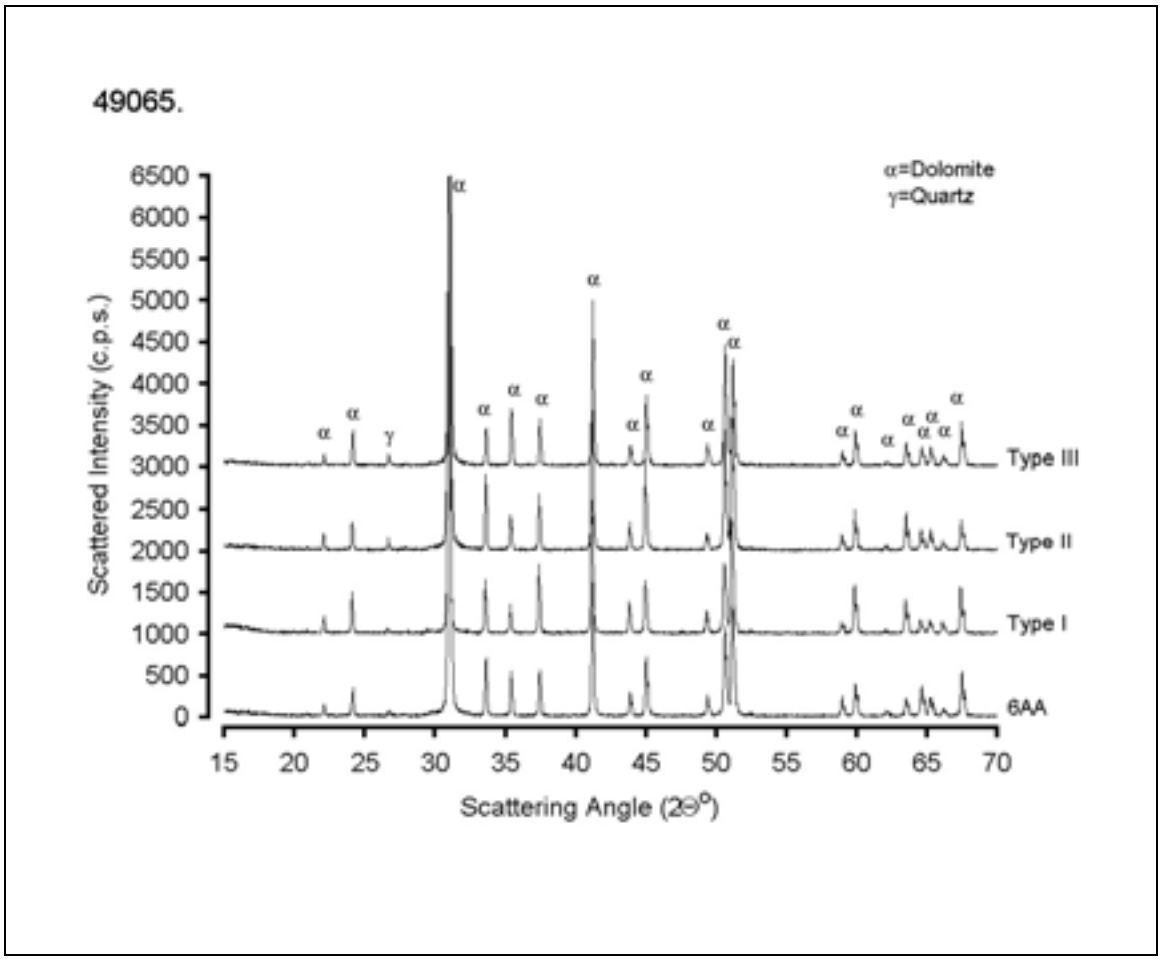


Figure 2-5: X-ray diffraction pattern from aggregate source.

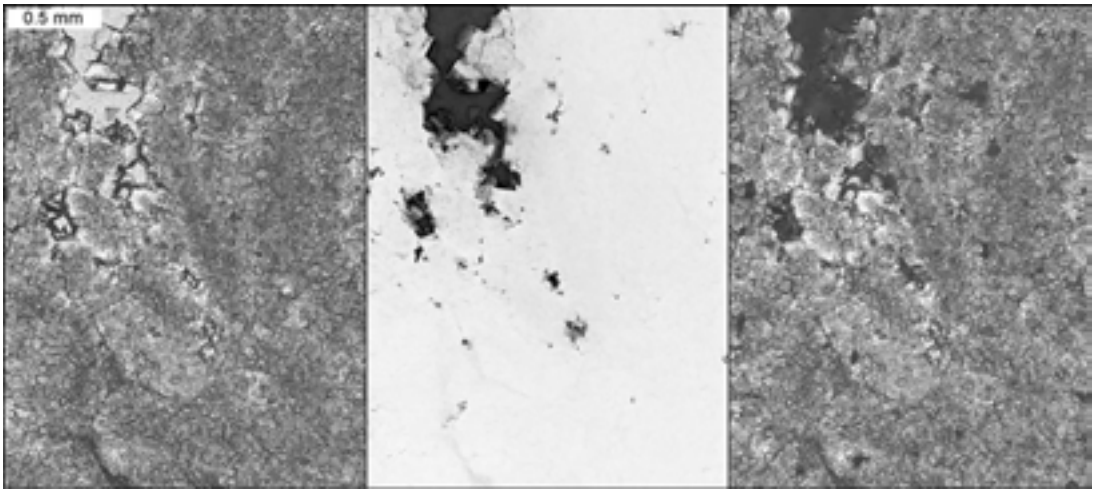


Figure 2-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

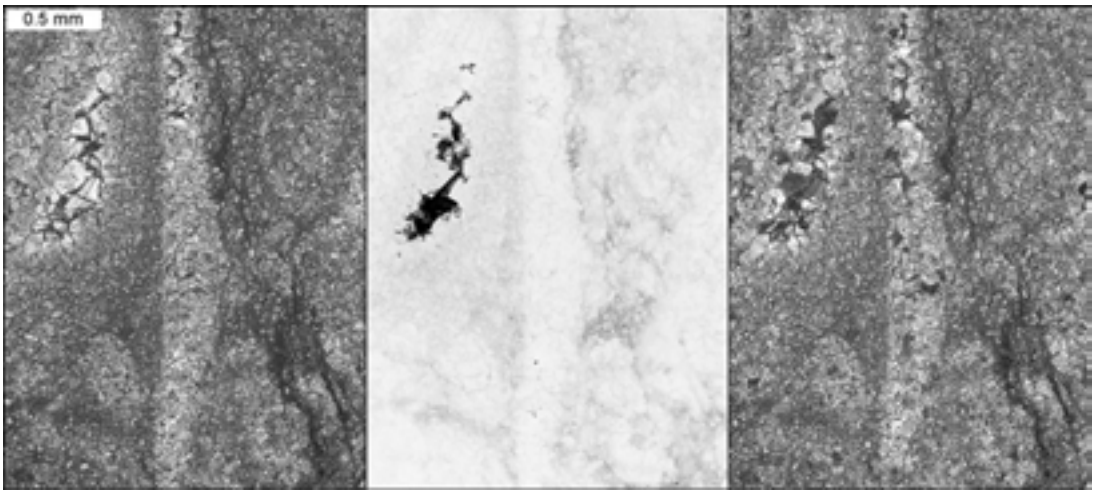


Figure 2-6b: Thin section micrographs for Type II, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

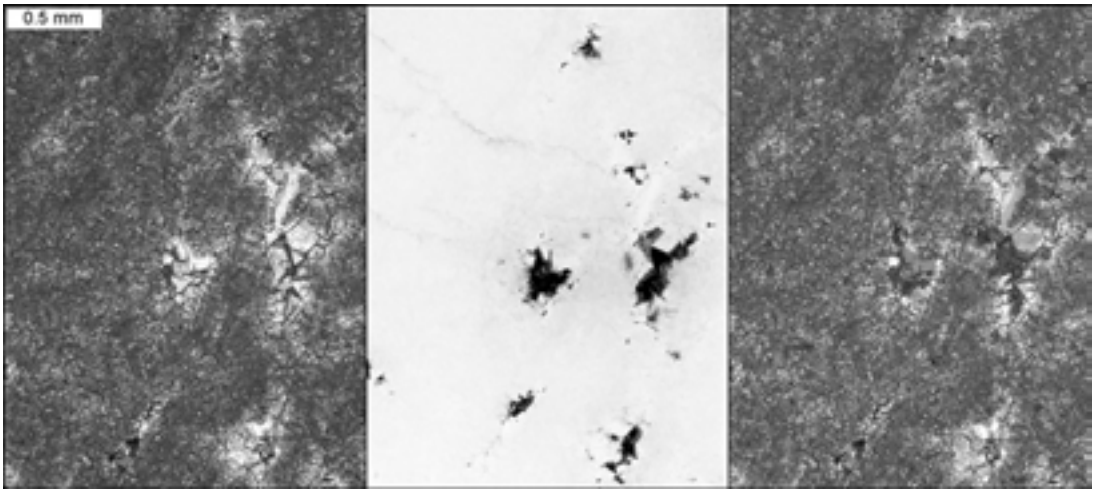


Figure 2-6c: Thin section micrographs for Type III, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

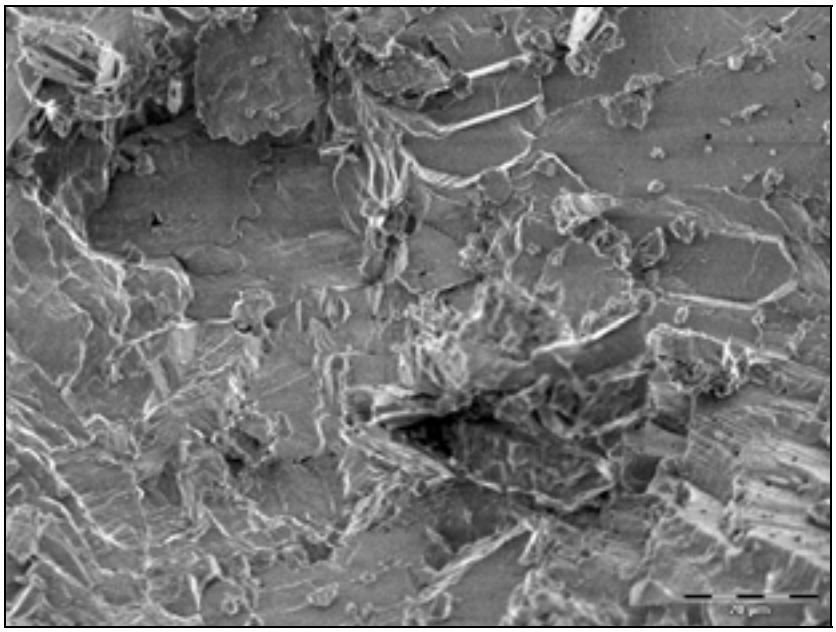


Figure 2-7a: ESEM photo of fracture surface for type I.

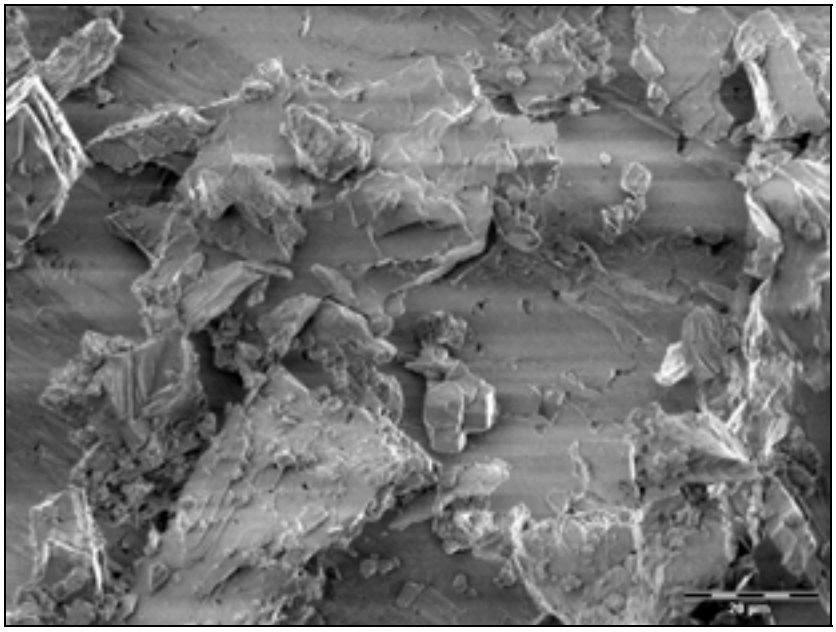


Figure 2-7b: ESEM photo of fracture surface for type II.

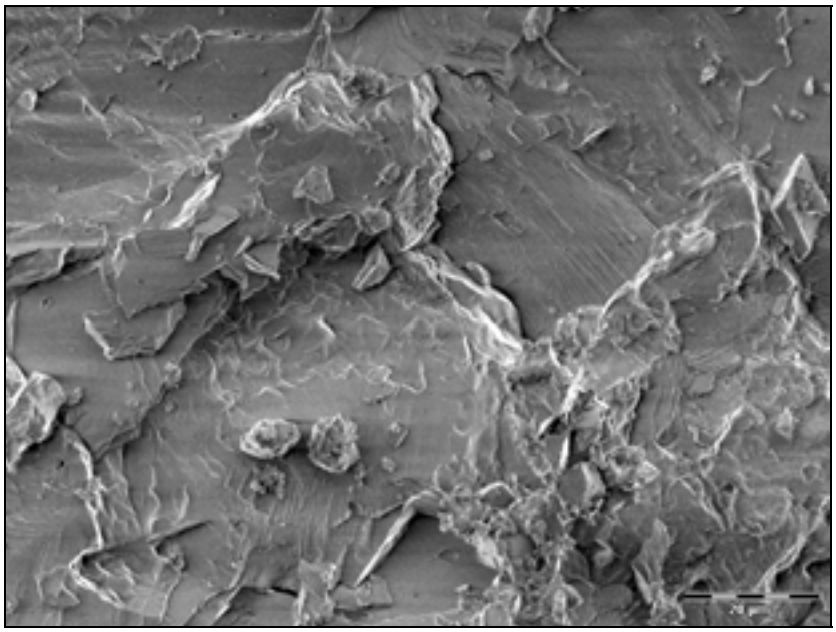


Figure 2-7c: ESEM photo of fracture surface for type III.

Table 2-9: Grain intercept length statistics, by type:

Grain intercept length (μm)	I	II	III
Average	171.8	107.2	128.3
Median	122.3	90.6	98.5
Standard deviation	150.8	65.9	93.8
Maximum	1392.2	519.2	955.7
Minimum	11.2	11.2	11.2

Table 2-10: Micro-pore diameter statistics, by type:

Micro-pore diameter (μm)	I	II	III
Average	1.74	1.62	1.75
Median	1.13	1.09	1.15
Standard deviation	2.05	1.61	1.86
Maximum	56.58	23.53	30.72
Minimum	0.60	0.60	0.60

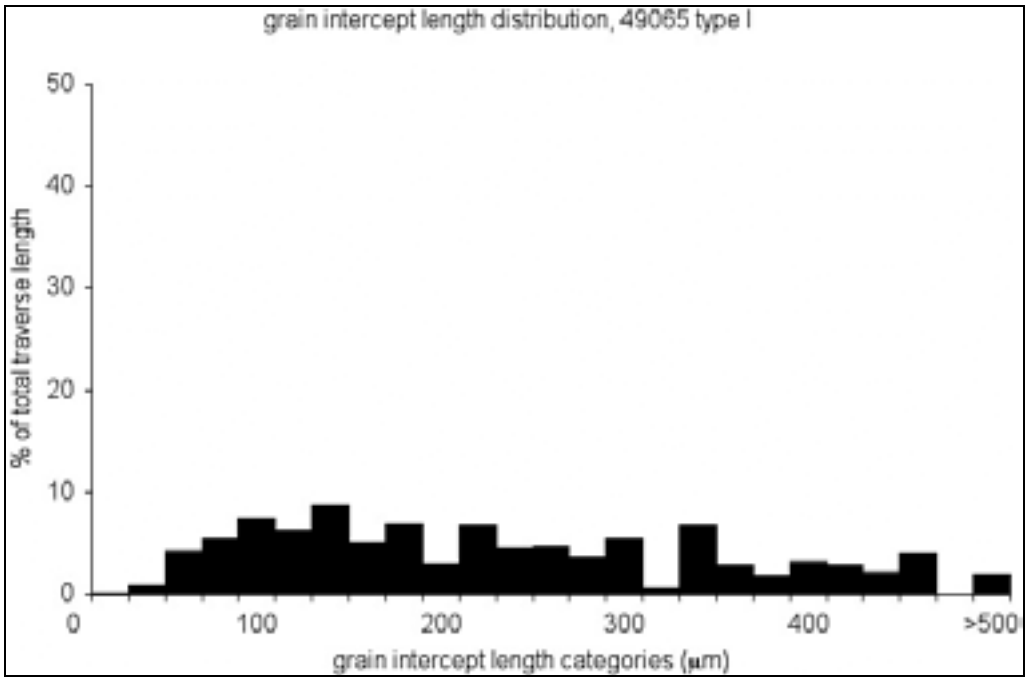


Figure 2-8a: Grain intercept length distribution from petrographic microscope traverse, Type I.

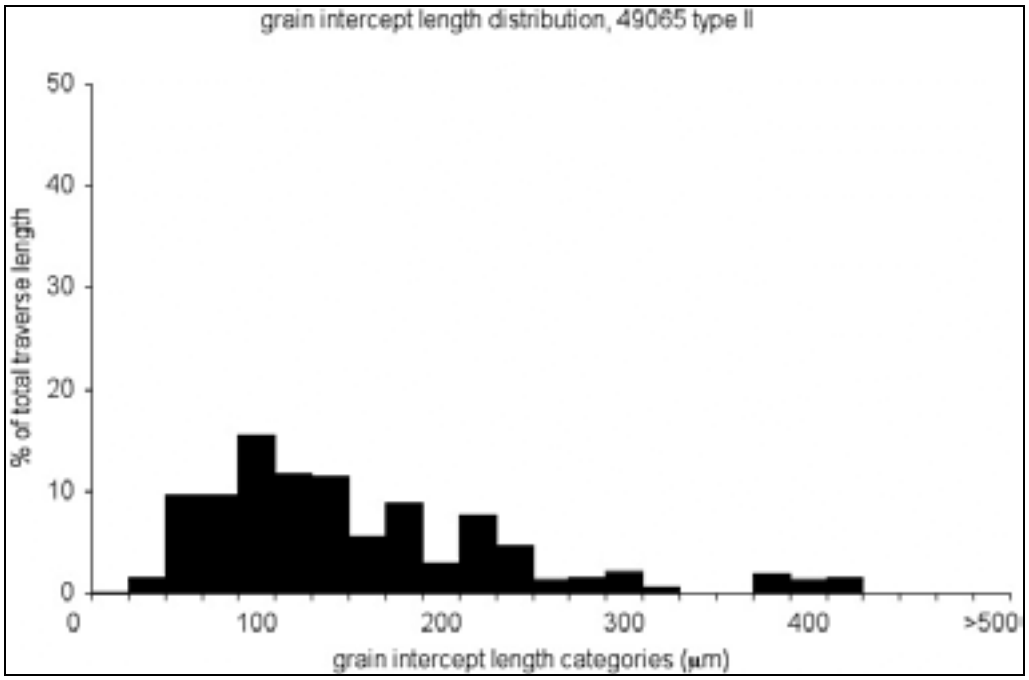


Figure 2-8b: Grain intercept length distribution from petrographic microscope traverse, Type II.

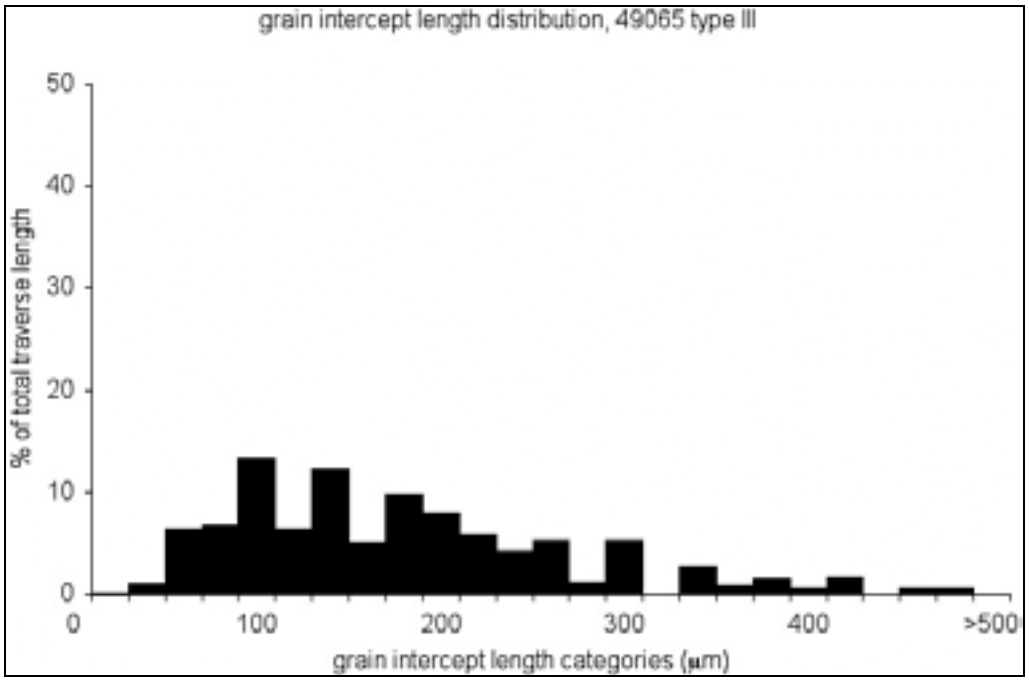


Figure 2-8c: Grain intercept length distribution from petrographic microscope traverse, Type III.

Table 2-11a: Data for grain intercept length distribution plot shown in Figure 2-8a, (type I):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	0.13	0.13
20 to <40	0.98	1.11
40 to <60	4.28	5.39
60 to <80	5.37	10.76
80 to <100	7.44	18.20
100 to <120	6.14	24.34
120 to <140	8.81	33.15
140 to <160	5.08	38.22
160 to <180	7.00	45.23
180 to <200	2.99	48.21
200 to <220	6.82	55.04
220 to <240	4.57	59.61
240 to <280	4.69	64.30
280 to <300	3.69	68.00
300 to <320	5.46	73.46
320 to <340	0.64	74.10
340 to <360	6.75	80.85
360 to <380	2.86	83.71
380 to <400	1.85	85.57
400 to <420	3.18	88.75
420 to <440	2.94	91.69
440 to <460	2.19	93.87
460 to <480	4.12	97.99
480 to <500	0.00	97.99
500 and >	2.01	100.00

Table 2-11b: Data for grain intercept length distribution plot shown in Figure 2-8b, (type II):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	0.14	0.14
20 to <40	1.48	1.62
40 to <60	9.69	11.31
60 to <80	9.61	20.92
80 to <100	15.51	36.44
100 to <120	11.78	48.21
120 to <140	11.44	59.65
140 to <160	5.54	65.19
160 to <180	8.98	74.17
180 to <200	3.09	77.26
200 to <220	7.70	84.95
220 to <240	4.66	89.62
240 to <280	1.33	90.95
280 to <300	1.49	92.44
300 to <320	2.14	94.58
320 to <340	0.56	95.14
340 to <360	0.00	95.14
360 to <380	0.00	95.14
380 to <400	1.99	97.13
400 to <420	1.41	98.54
420 to <440	1.46	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 2-11c: Data for grain intercept length distribution plot shown in Figure 2-8c, (type III):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	0.22	0.22
20 to <40	1.02	1.25
40 to <60	6.37	7.62
60 to <80	6.77	14.38
80 to <100	13.35	27.73
100 to <120	6.41	34.14
120 to <140	12.28	46.42
140 to <160	5.13	51.55
160 to <180	9.89	61.44
180 to <200	8.07	69.50
200 to <220	5.92	75.42
220 to <240	4.23	79.65
240 to <280	5.23	84.88
280 to <300	1.15	86.03
300 to <320	5.28	91.31
320 to <340	0.00	91.31
340 to <360	2.70	94.01
360 to <380	0.96	94.98
380 to <400	1.51	96.49
400 to <420	0.53	97.02
420 to <440	1.71	98.73
440 to <460	0.00	98.73
460 to <480	0.62	99.35
480 to <500	0.65	100.00
500 and >	0.00	100.00

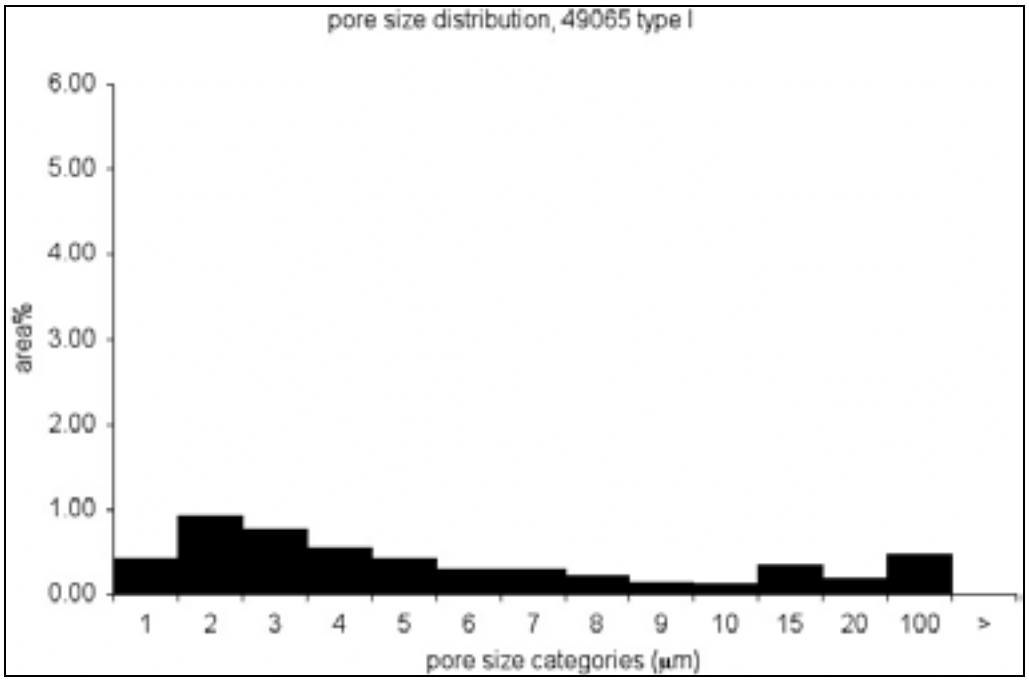


Figure 2-9a: Micro-pore size distribution from back-scattered electron images, type I.

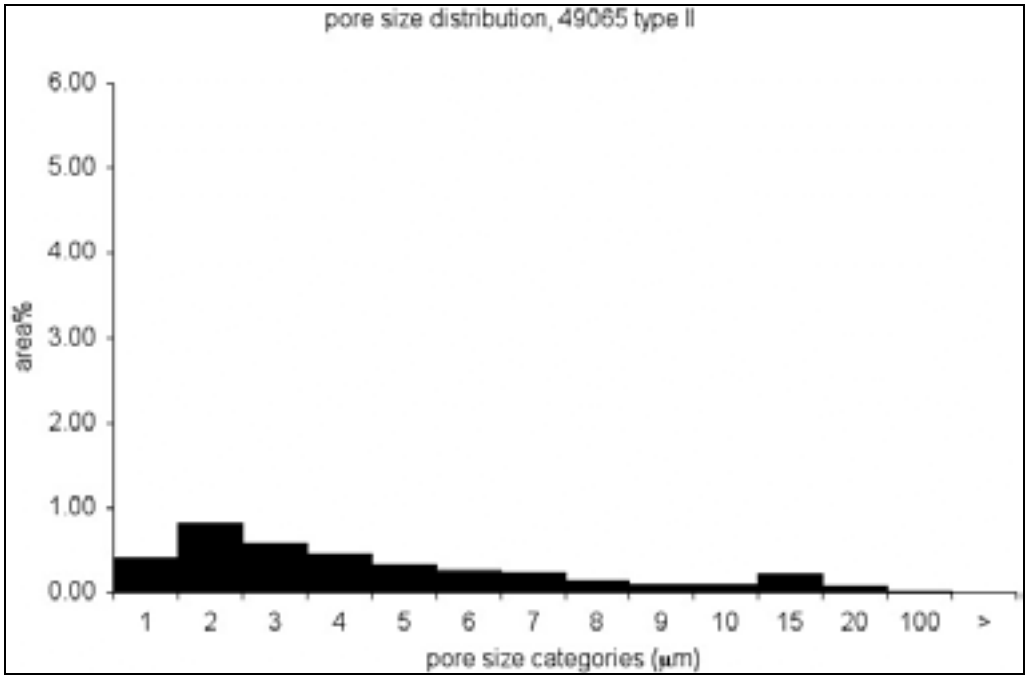


Figure 2-9b: Micro-pore size distribution from back-scattered electron images, type II.

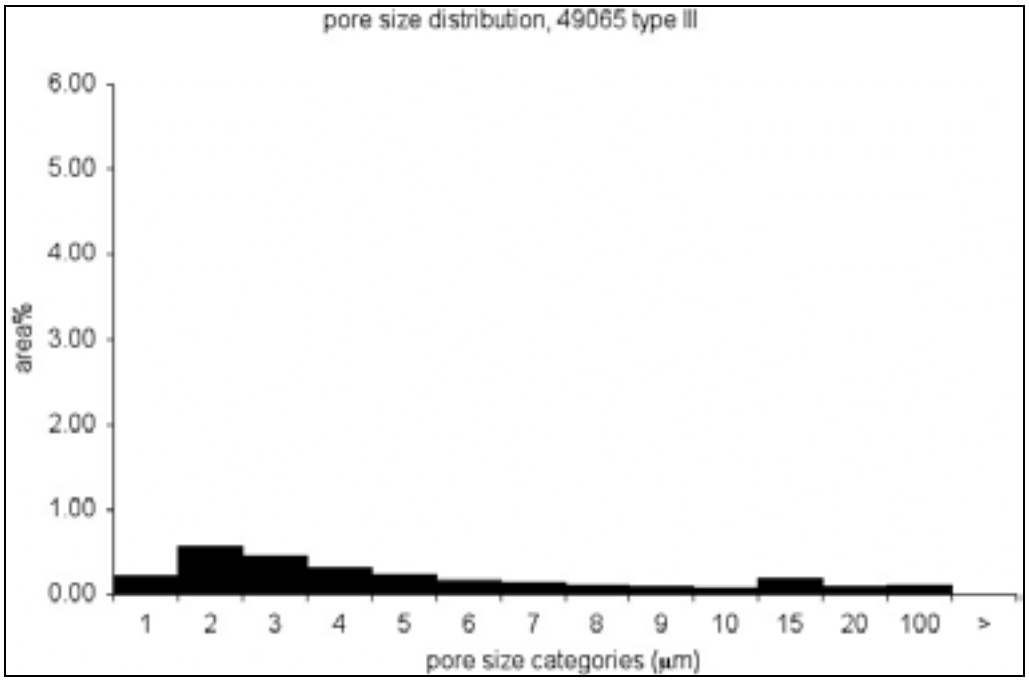


Figure 2-9c: Micro-pore size distribution from back-scattered electron images, type III.

Table 2-12a: Data for micro-pore size distribution plot shown in Figure 2-9a, (type I).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.41	7.99
1 to <2	0.93	26.15
2 to <3	0.77	41.17
3 to <4	0.55	51.85
4 to <5	0.42	60.08
5 to <6	0.29	65.78
6 to <7	0.29	71.36
7 to <8	0.21	75.46
8 to <9	0.14	78.13
9 to <10	0.13	80.60
10 to <15	0.34	87.17
15 to <20	0.18	90.70
20 to <100	0.48	100.00
100 and >	0.00	100.00
sum	5.12	

Table 2-12b: Data for micro-pore size distribution plot shown in Figure 2-9b, (type II).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.39	10.57
1 to <2	0.81	32.40
2 to <3	0.58	48.18
3 to <4	0.45	60.26
4 to <5	0.33	69.12
5 to <6	0.26	76.04
6 to <7	0.24	82.58
7 to <8	0.15	86.71
8 to <9	0.09	89.04
9 to <10	0.09	91.56
10 to <15	0.21	97.20
15 to <20	0.08	99.38
20 to <100	0.02	100.00
100 and >	0.00	100.00
sum	3.70	

Table 2-12c: Data for micro-pore size distribution plot shown in Figure 2-9c, (type III).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.23	8.21
1 to <2	0.56	28.60
2 to <3	0.46	45.37
3 to <4	0.31	56.53
4 to <5	0.24	65.18
5 to <6	0.17	71.38
6 to <7	0.14	76.63
7 to <8	0.12	80.86
8 to <9	0.08	83.85
9 to <10	0.06	86.17
10 to <15	0.18	92.87
15 to <20	0.09	96.22
20 to <100	0.10	100.00
100 and >	0.00	100.00
sum	2.74	

Table 2-13: Coefficient of thermal expansion, by type:

Type	Coefficient of thermal expansion (mm/mm/degree C):
I	7.83E-06
II	7.46E-06
III	8.25E-06

58003 - Ottawa Lake

Table 3-1: Pit name, location, and general geologic information:

Pit Number	58003
Name	Ottawa Lake
Longitude	-83.66
Latitude	41.75
Era	Palaeozoic
Period	Devonian
Group	Basswood Island
Member	
Rock Type	dolomite
Description	Gray to tan fine to medium grained dolomite.

Table 3-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	7.795E-06
Bulk specific gravity (oven dry)	2.64
Bulk specific gravity (saturated surface dry)	2.69
Apparent specific gravity	2.79
Absorption %	1.98
Average grain intercept length (µm)	48.8
Area % micro-pores	13.88
Average micro-pore diameter (µm)	1.94

Figure 3-1: Photo of 3/8" sieve fraction of 6AA product.

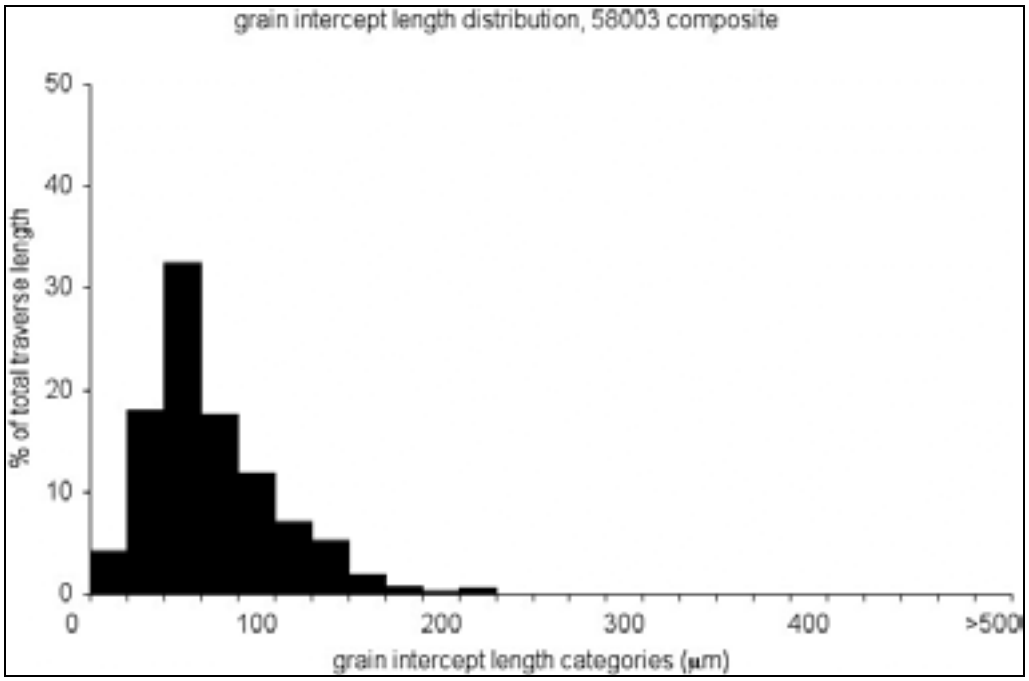


Figure 3-2: Grain intercept length distribution from petrographic microscope traverse.

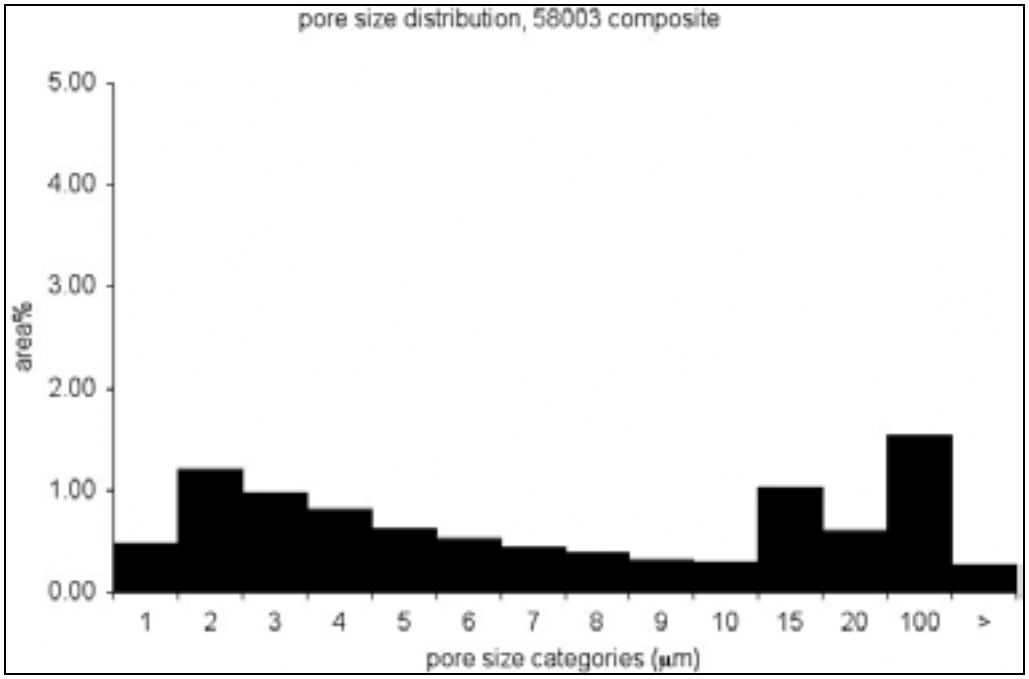


Figure 3-3: Micro-pore size distribution from back-scattered electron images.

Table 3-3: Data for grain intercept length distribution plot shown in Figure 3-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	4.16	4.16
20 to <40	17.90	22.06
40 to <60	32.43	54.49
60 to <80	17.66	72.15
80 to <100	11.94	84.09
100 to <120	7.12	91.20
120 to <140	5.22	96.42
140 to <160	1.94	98.36
160 to <180	0.75	99.11
180 to <200	0.28	99.39
200 to <220	0.61	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 3-4: Data for micro-pore size distribution plot shown in Figure 3-3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.48	5.05
1 to <2	1.20	17.69
2 to <3	0.98	27.99
3 to <4	0.81	36.49
4 to <5	0.62	43.00
5 to <6	0.53	48.52
6 to <7	0.44	53.16
7 to <8	0.40	57.35
8 to <9	0.31	60.62
9 to <10	0.30	63.78
10 to <15	1.02	74.51
15 to <20	0.61	80.87
20 to <100	1.54	97.07
100 and >	0.28	100.00
sum	9.53	

Table 3-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	21.02
Al_2O_3	0.29
SiO_2	1.57
S	0.06
CaO	30.01
Fe_2O_3	0.28
sum	53.25

Table 3-6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	96.19
Calcite - $CaCO_3$	1.35
Pyrite - FeS_2	0.12
Other	1.57
sum	99.23

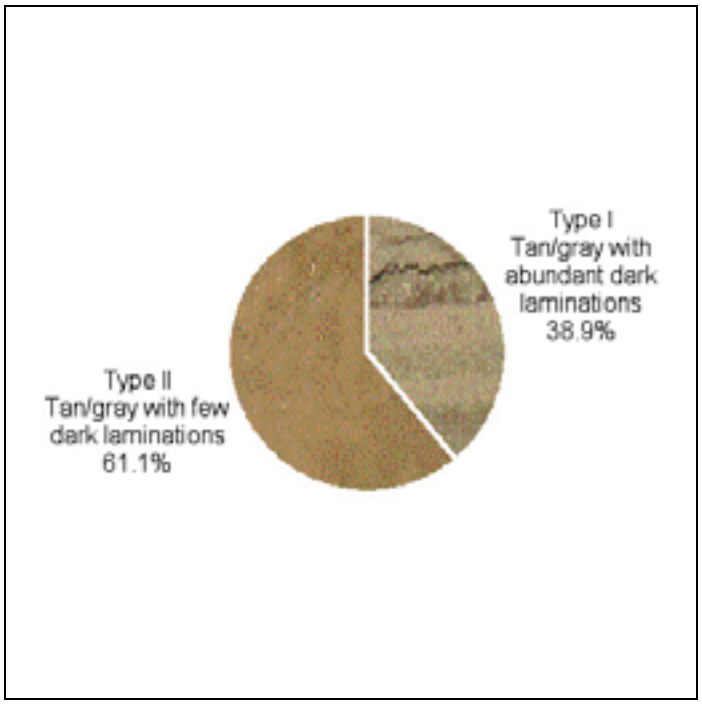


Figure 3-4: Rock types within aggregate source based on differences in color and texture.

Table 3-7: Composition as determined by x-ray fluorescence, by type:

Oxide/element wt%	I	II
MgO	20.80	21.31
Al_2O_3	0.56	0.14
SiO_2	2.66	0.76
S	0.07	0.04
CaO	29.24	30.62
Fe_2O_3	0.37	0.20
sum	53.70	53.07

Table 3-8: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral wt%	I	II
Dolomite - $Ca,Mg(CO_3)_2$	95.15	97.51
Calcite - $CaCO_3$	0.54	1.72
Pyrite - FeS_2	0.13	0.07
Other	2.66	0.76
sum	98.48	100.06

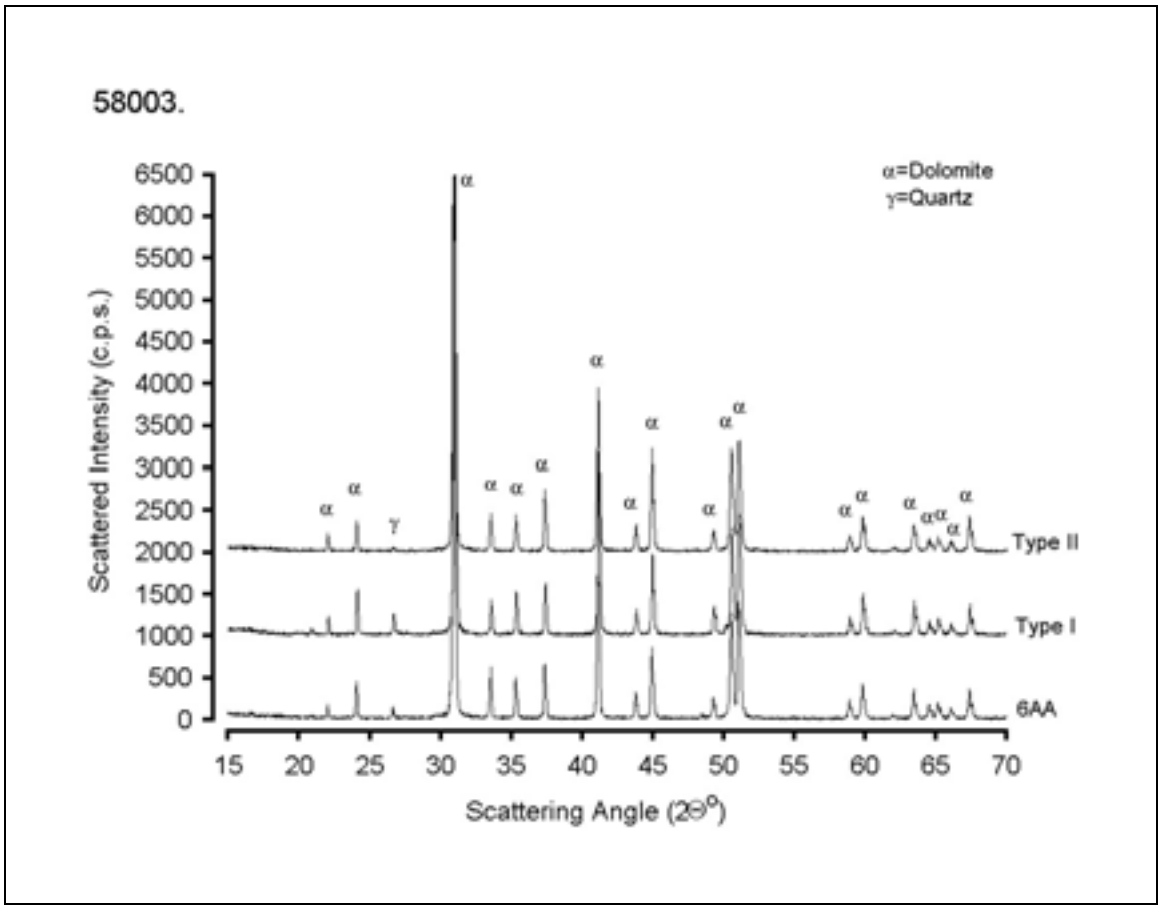


Figure 3-5: X-ray diffraction pattern from aggregate source.

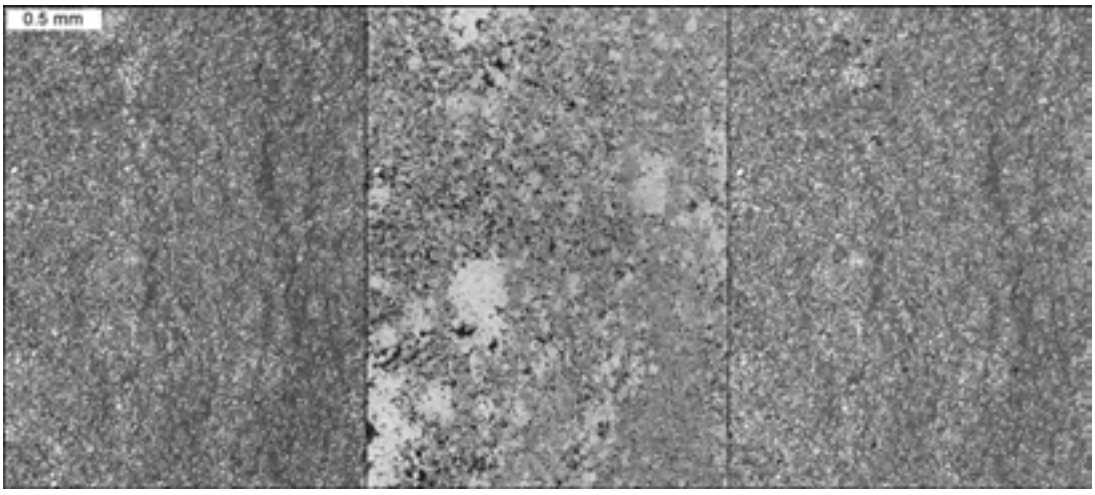


Figure 3-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

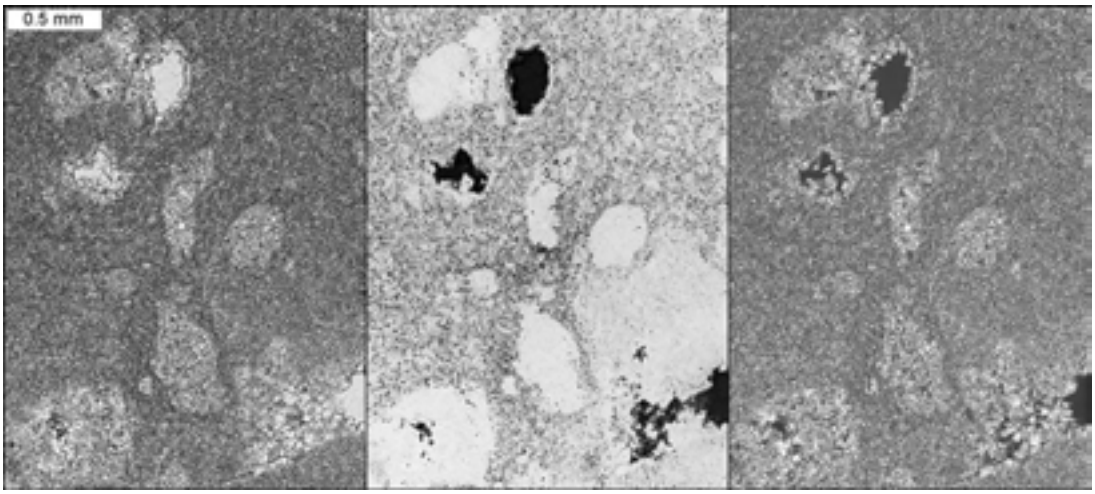


Figure 3-6b: Thin section micrographs for Type II, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

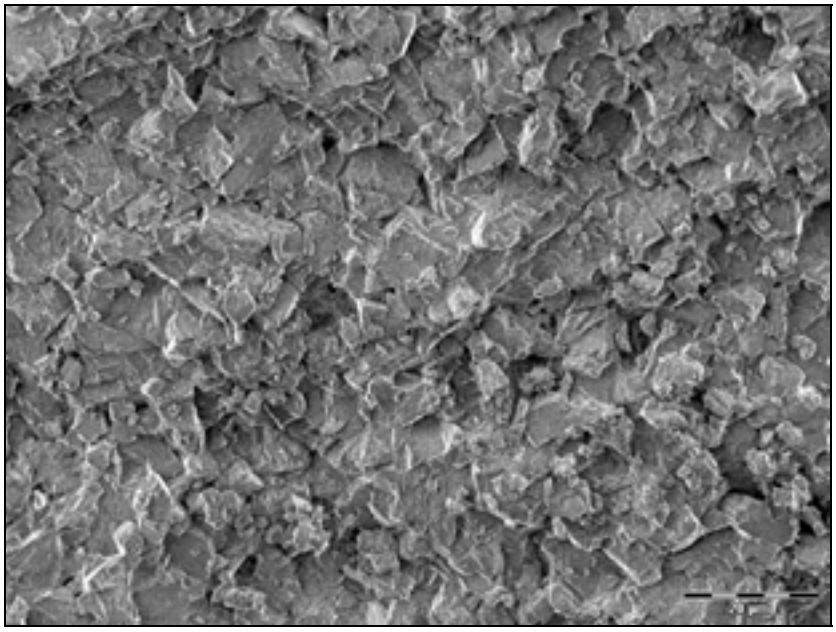


Figure 3-7a: ESEM photo of fracture surface for type I.

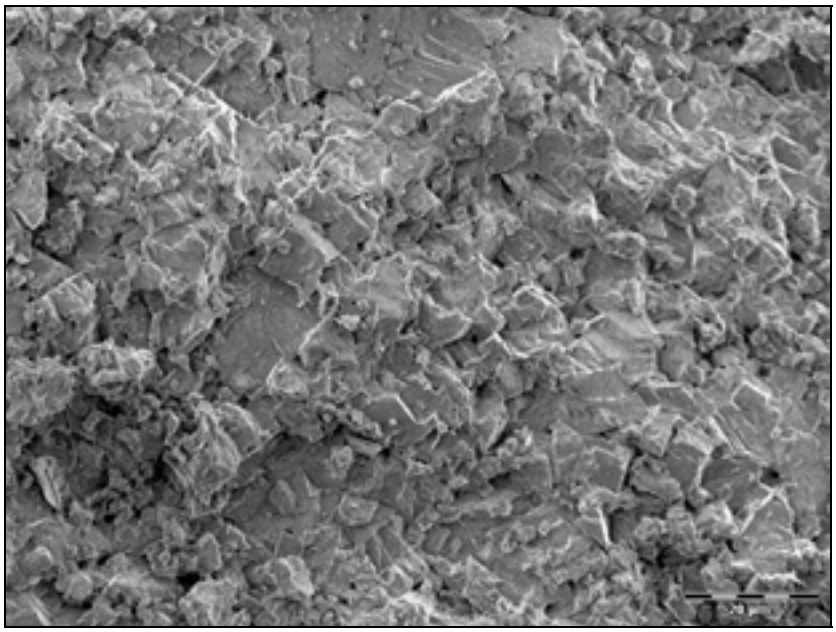


Figure 3-7b: ESEM photo of fracture surface for type II.

Table 3-9: Grain intercept length statistics, by type:

Grain intercept length (μm)	I	II
Average	46.9	50.0
Median	40.5	44.4
Standard deviation	30.8	27.9
Maximum	211.7	157.3
Minimum	13.3	13.3

Table 3-10: Micro-pore diameter statistics, by type:

Micro-pore diameter (μm)	I	II
Average	2.01	1.89
Median	1.22	1.22
Standard deviation	2.66	2.20
Maximum	60.51	107.00
Minimum	0.60	0.60

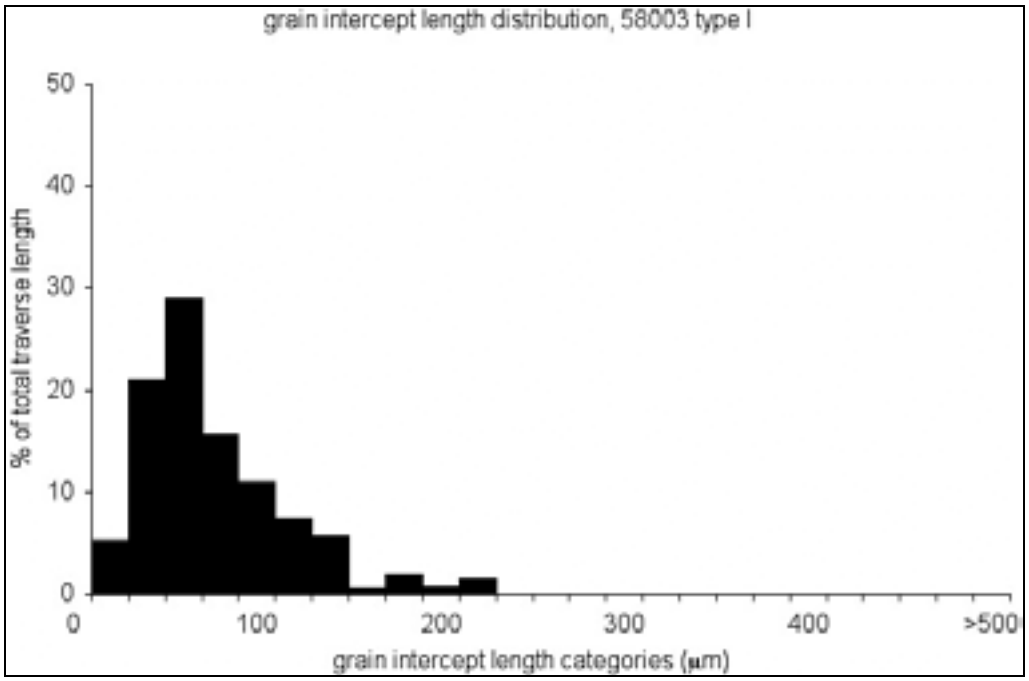


Figure 3-8a: Grain intercept length distribution from petrographic microscope traverse, Type I.

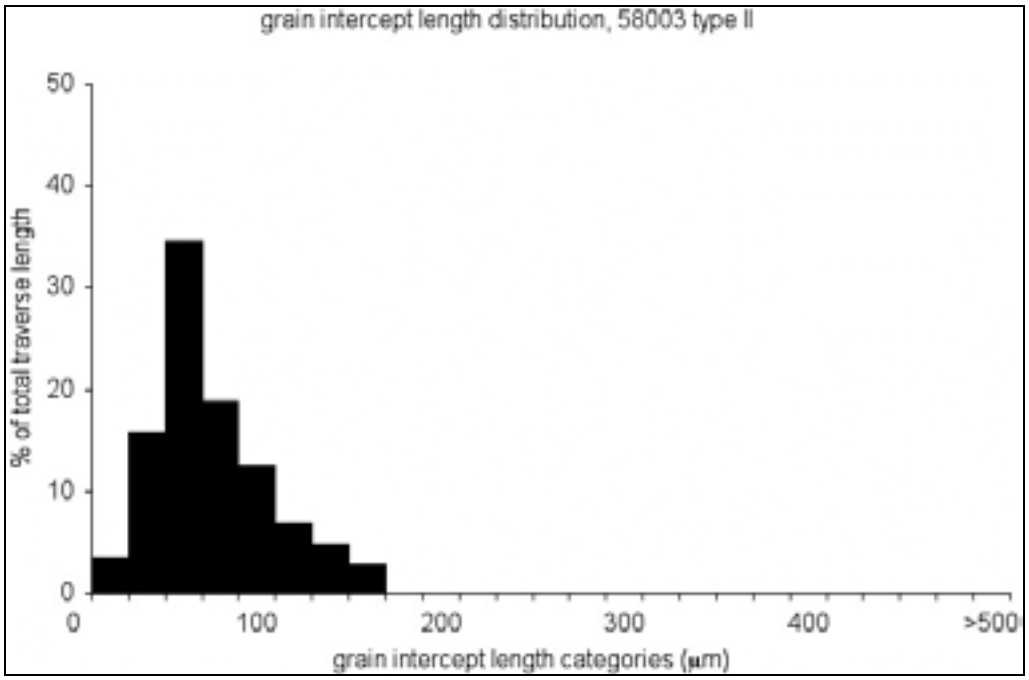


Figure 3-8b: Grain intercept length distribution from petrographic microscope traverse, Type II.

Table 3-11a: Data for grain intercept length distribution plot shown in Figure 3-8a, (type I):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	5.35	5.35
20 to <40	21.06	26.41
40 to <60	29.00	55.41
60 to <80	15.68	71.09
80 to <100	11.01	82.10
100 to <120	7.42	89.52
120 to <140	5.72	95.24
140 to <160	0.55	95.79
160 to <180	1.93	97.72
180 to <200	0.72	98.44
200 to <220	1.56	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 3-11b: Data for grain intercept length distribution plot shown in Figure 3-8b, (type II):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	3.40	3.40
20 to <40	15.90	19.30
40 to <60	34.60	53.90
60 to <80	18.91	72.82
80 to <100	12.53	85.35
100 to <120	6.93	92.27
120 to <140	4.90	97.17
140 to <160	2.83	100.00
160 to <180	0.00	100.00
180 to <200	0.00	100.00
200 to <220	0.00	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

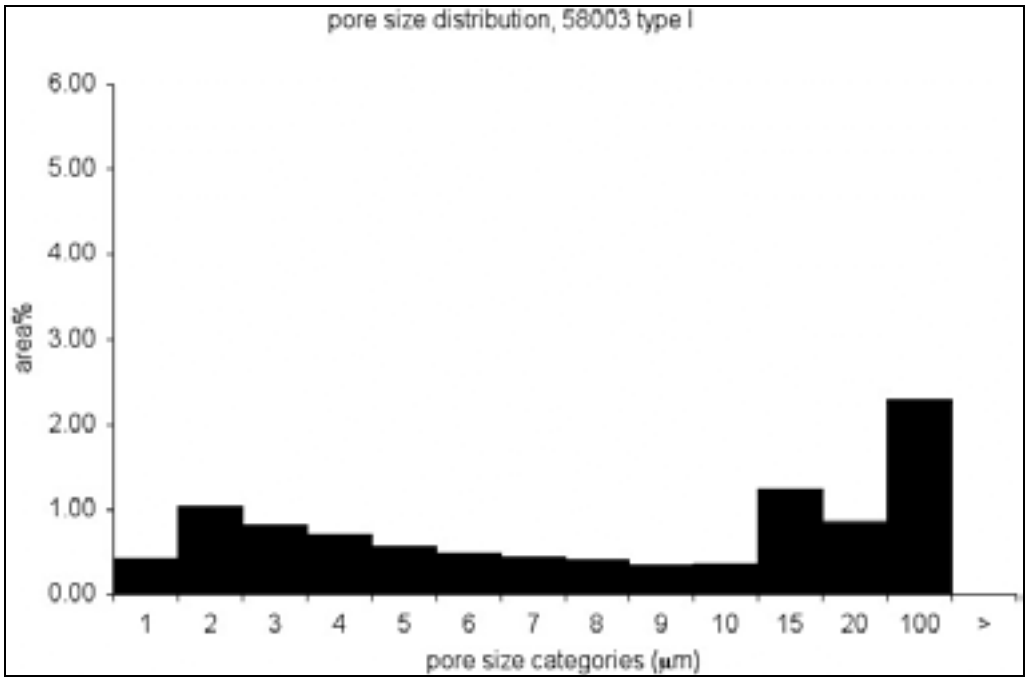


Figure 3-9a: Micro-pore size distribution from back-scattered electron images, type I.

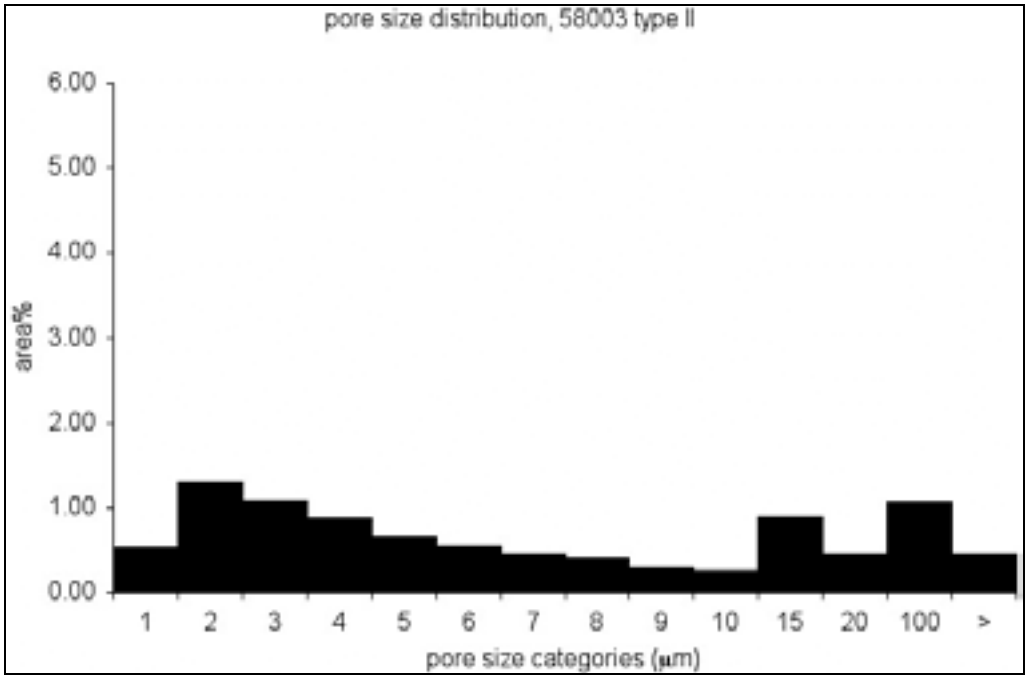


Figure 3-9b: Micro-pore size distribution from back-scattered electron images, type II.

Table 3-12a: Data for micro-pore size distribution plot shown in Figure 3-9a, (type I).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.42	4.20
1 to <2	1.04	14.68
2 to <3	0.82	22.99
3 to <4	0.70	30.08
4 to <5	0.56	35.74
5 to <6	0.49	40.64
6 to <7	0.43	44.97
7 to <8	0.39	48.94
8 to <9	0.35	52.47
9 to <10	0.36	56.12
10 to <15	1.23	68.49
15 to <20	0.85	77.03
20 to <100	2.28	100.00
100 and >	0.00	100.00
sum	9.92	

Table 3-12b: Data for micro-pore size distribution plot shown in Figure 3-9b, (type II).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.52	5.63
1 to <2	1.31	19.74
2 to <3	1.08	31.40
3 to <4	0.88	40.85
4 to <5	0.66	47.93
5 to <6	0.55	53.88
6 to <7	0.45	58.72
7 to <8	0.40	63.07
8 to <9	0.29	66.16
9 to <10	0.26	68.98
10 to <15	0.89	78.60
15 to <20	0.45	83.48
20 to <100	1.08	95.09
100 and >	0.46	100.00
sum	9.28	

Table 3-13: Coefficient of thermal expansion, by type:

Type	Coefficient of thermal expansion (mm/mm/degree C):
I	7.74E-06
II	7.85E-06

58008 - Rockwood

Table 4-1: Pit name, location, and general geologic information:

Pit Number	58008
Name	Rockwood
Longitude	-83.23
Latitude	42.01
Era	Palaeozoic
Period	Devonian
Group	Basswood Island
Member	
Rock Type	dolomite
Description	Light tan to gray, dark brown to gray fine to medium grained dolomite.

Table 4-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	8.032E-06
Bulk specific gravity (oven dry)	2.57
Bulk specific gravity (saturated surface dry)	2.64
Apparent specific gravity	2.77
Absorption %	2.75
Average grain intercept length (µm)	55.9
Area % micro-pores	17.79
Average micro-pore diameter (µm)	1.59

Figure 4-1: Photo of 3/8" sieve fraction of 6AA product.

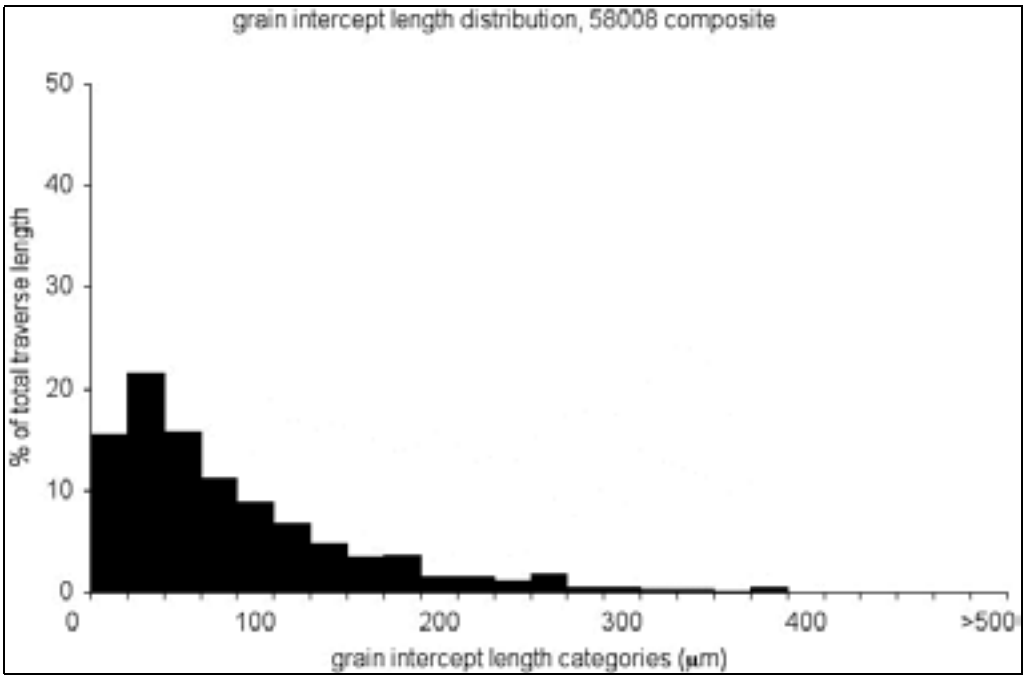


Figure 4-2: Grain intercept length distribution from petrographic microscope traverse.

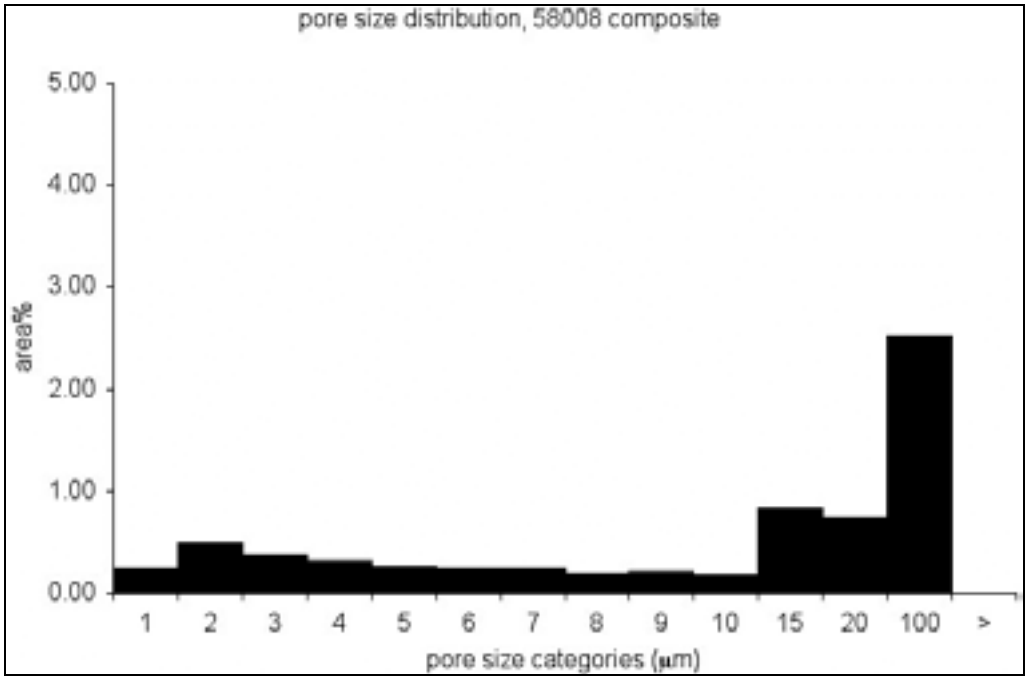


Figure 4-3: Micro-pore size distribution from back-scattered electron images.

Table 4-3: Data for grain intercept length distribution plot shown in Figure 4-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	15.57	15.57
20 to <40	21.61	37.18
40 to <60	15.88	53.07
60 to <80	11.20	64.26
80 to <100	8.87	73.14
100 to <120	6.77	79.91
120 to <140	4.86	84.77
140 to <160	3.49	88.26
160 to <180	3.65	91.91
180 to <200	1.46	93.37
200 to <220	1.50	94.87
220 to <240	1.16	96.02
240 to <280	1.86	97.88
280 to <300	0.44	98.32
300 to <320	0.47	98.79
320 to <340	0.37	99.16
340 to <360	0.26	99.43
360 to <380	0.14	99.56
380 to <400	0.44	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 4-4: Data for micro-pore size distribution plot shown in Figure 4-3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.25	3.63
1 to <2	0.49	10.88
2 to <3	0.37	16.36
3 to <4	0.31	20.92
4 to <5	0.26	24.74
5 to <6	0.24	28.26
6 to <7	0.24	31.76
7 to <8	0.19	34.57
8 to <9	0.21	37.63
9 to <10	0.18	40.20
10 to <15	0.83	52.33
15 to <20	0.73	63.08
20 to <100	2.52	100.00
100 and >	0.00	100.00
sum	6.82	

Table 4-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	20.07
Al_2O_3	0.31
SiO_2	3.87
S	0.14
CaO	29.43
Fe_2O_3	0.38
sum	54.21

Table 4-6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	91.83
Calcite - $CaCO_3$	2.69
Pyrite - FeS_2	0.27
Other	3.87
sum	98.66

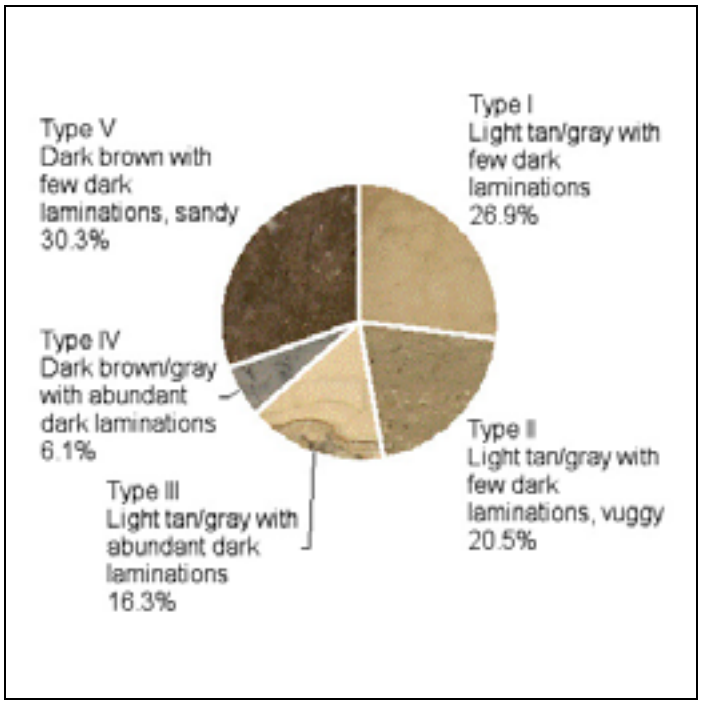


Figure 4-4: Rock types within aggregate source based on differences in color and texture.

Table 4-7: Composition as determined by x-ray fluorescence, by type:

Oxide/element wt%	I	II	III	IV	V
MgO	19.70	21.39	21.14	20.14	16.82
Al_2O_3	0.24	0.10	0.24	1.07	0.44
SiO_2	9.65	0.61	1.10	5.35	28.07
S	0.16	0.07	0.15	0.14	0.28
CaO	26.67	30.57	30.02	27.74	20.04
Fe_2O_3	1.17	0.16	0.23	0.36	2.51
sum	57.58	52.89	52.87	54.80	68.16

Table 4-8: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral wt%	I	II	III	IV	V
Dolomite - $Ca,Mg(CO_3)_2$	87.69	97.85	96.74	91.23	65.90
Calcite - $CaCO_3$	0.00	1.45	1.07	0.00	0.00
Pyrite - FeS_2	0.29	0.12	0.28	0.26	0.53
Other	9.65	0.61	1.10	5.35	28.07
sum	97.62	100.04	99.18	96.84	94.49

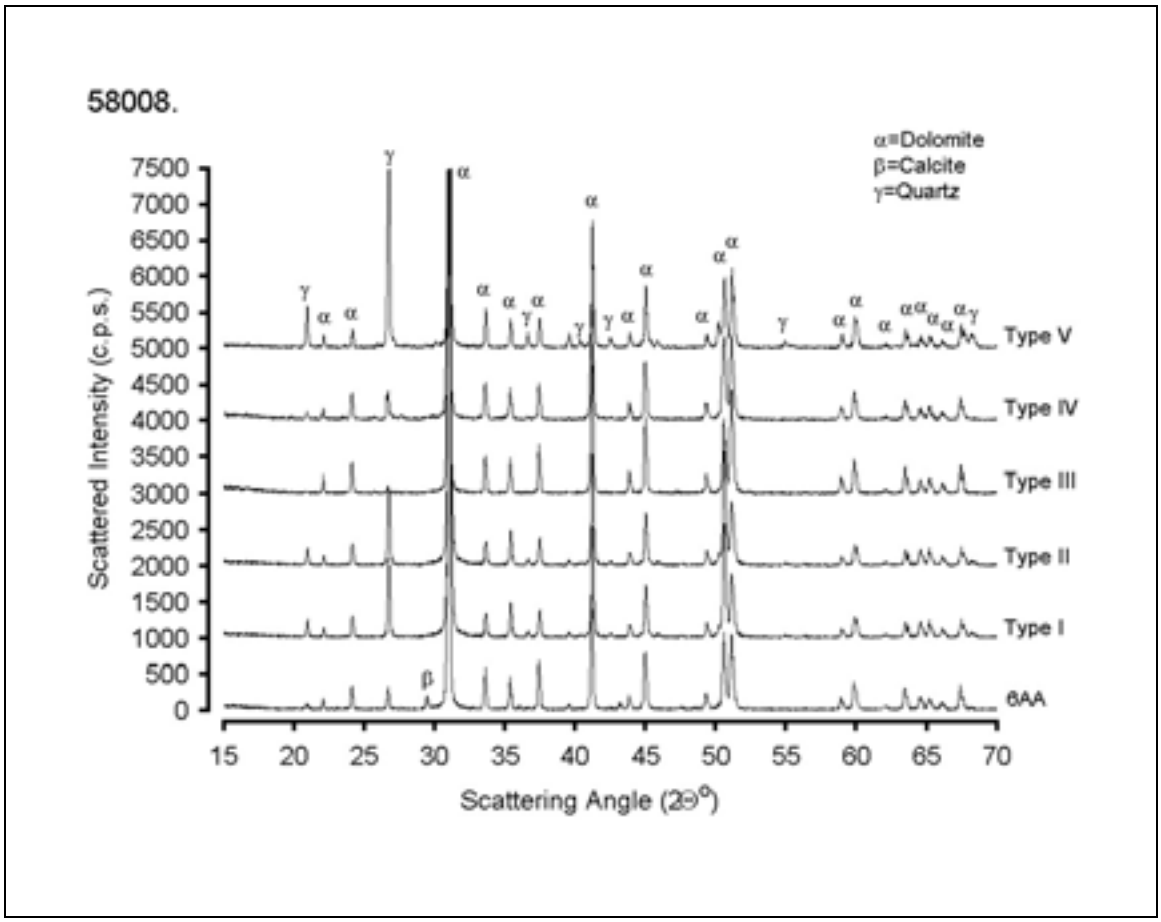


Figure 4-5: X-ray diffraction pattern from aggregate source.

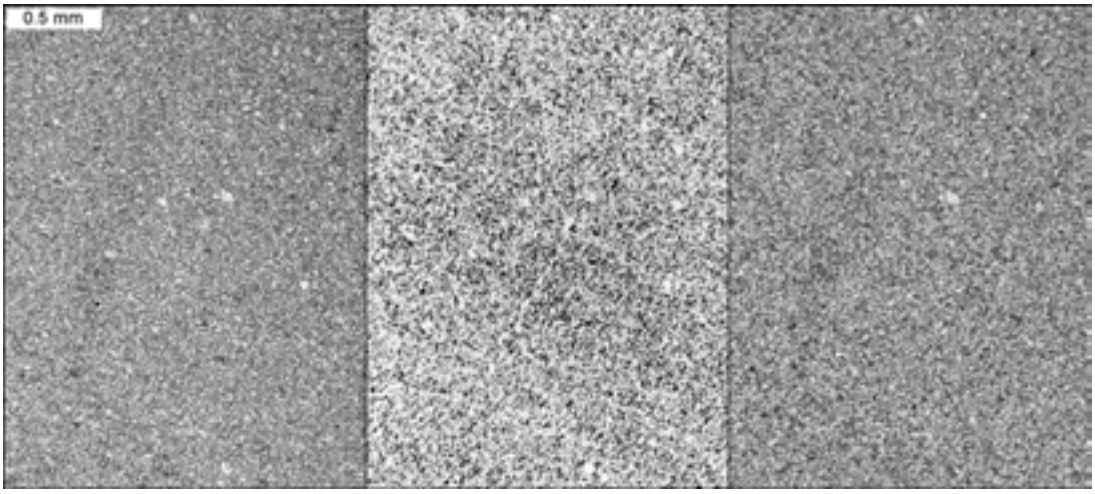


Figure 4-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

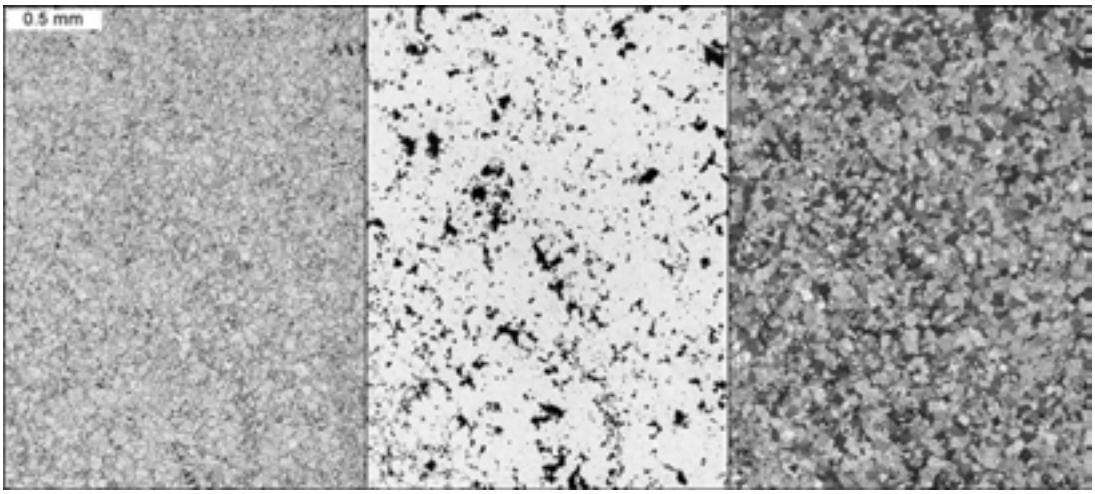


Figure 4-6b: Thin section micrographs for Type II, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

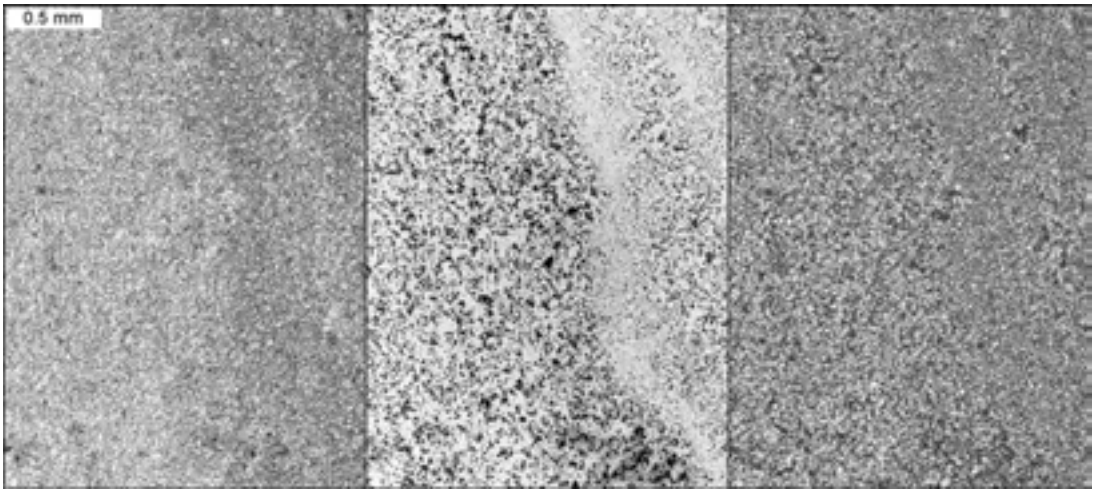


Figure 4-6c: Thin section micrographs for Type III, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

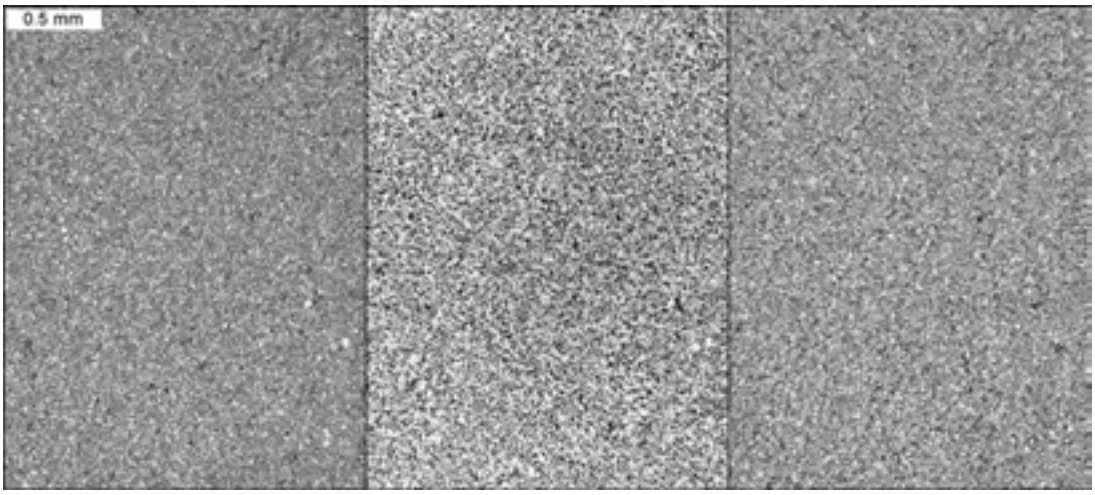


Figure 4-6d: Thin section micrographs for Type IV, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

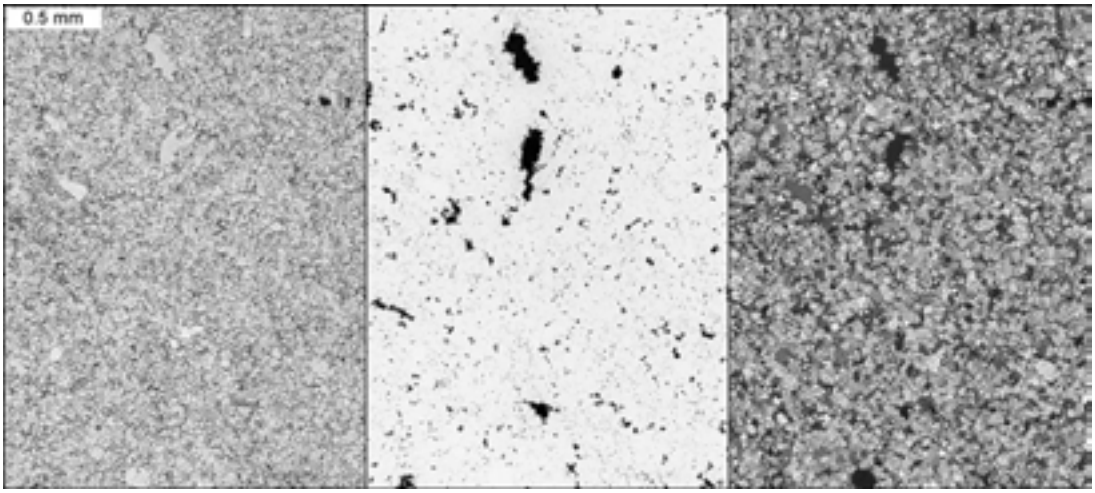


Figure 4-6e: Thin section micrographs for Type V, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

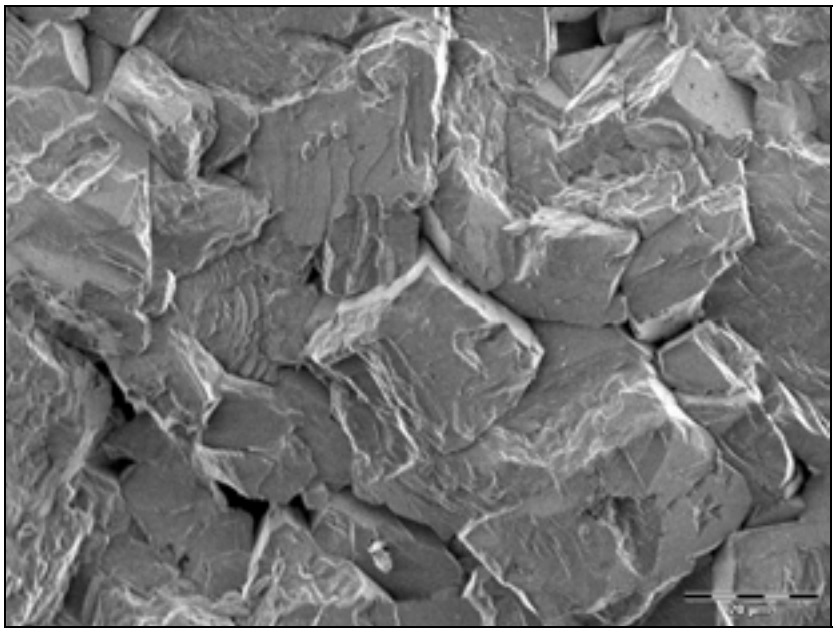


Figure 4-7a: ESEM photo of fracture surface for type I.

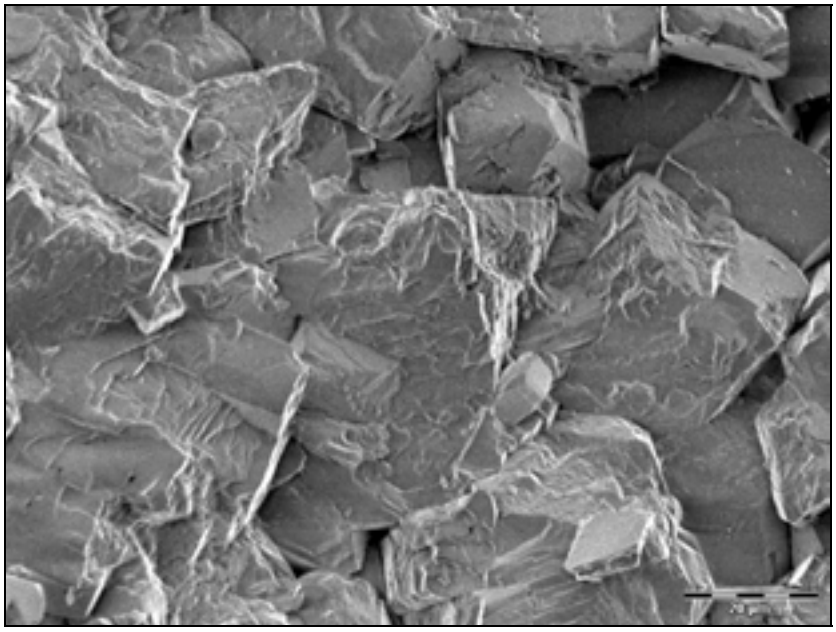


Figure 4-7b: ESEM photo of fracture surface for type II.

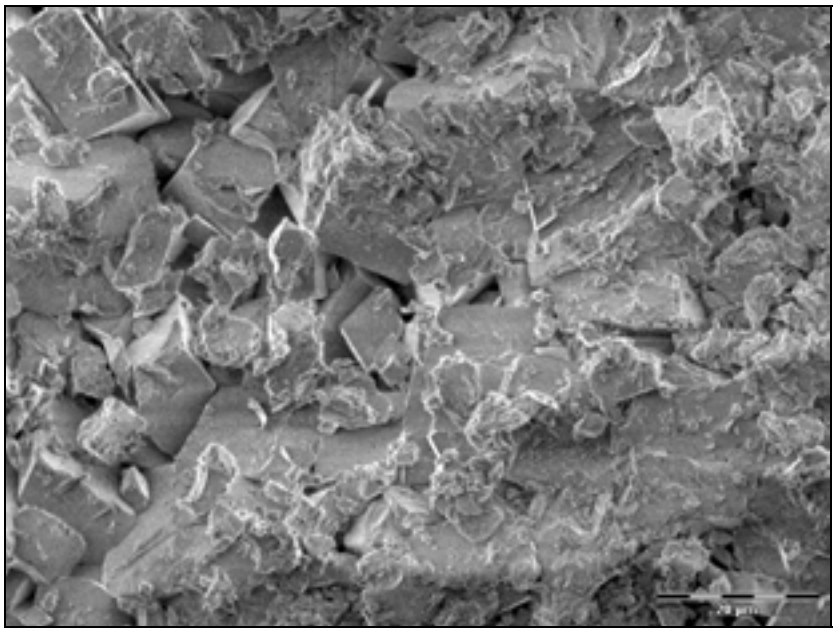


Figure 4-7c: ESEM photo of fracture surface for type III.

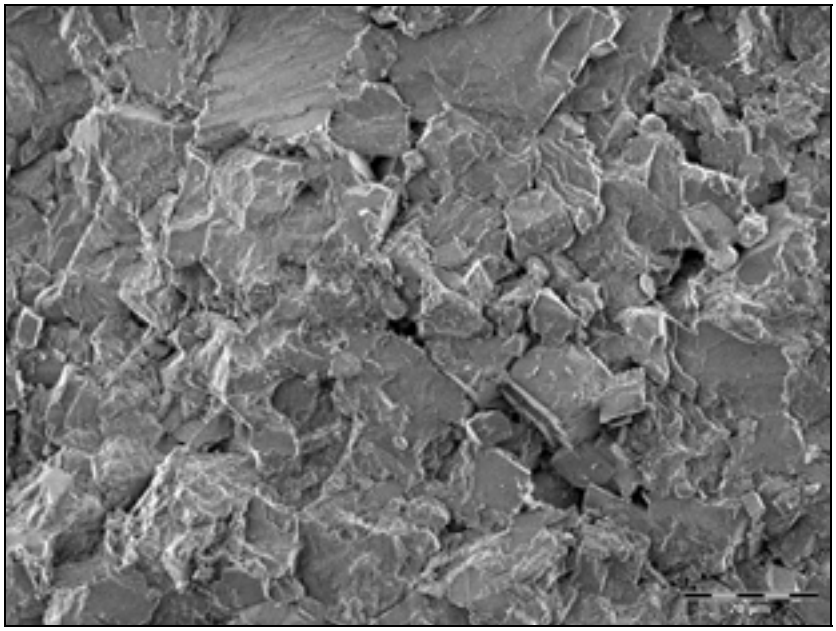


Figure 4-7d: ESEM photo of fracture surface for type IV.

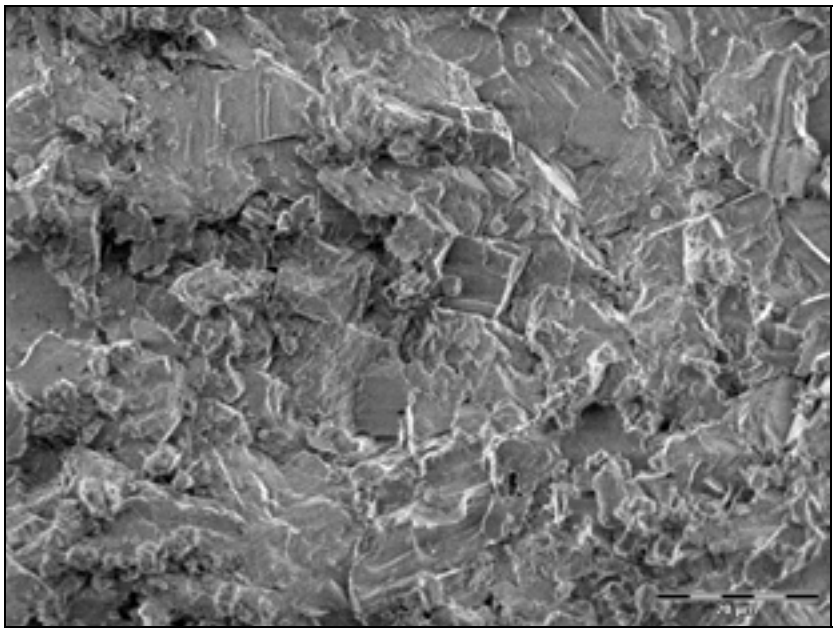


Figure 4-7e: ESEM photo of fracture surface for type V.

Table 4-9: Grain intercept length statistics, by type:

Grain intercept length (μm)	I	II	III	IV	V
Average	105.2	58.6	51.9	9.8	21.9
Median	90.6	22.4	40.5	7.2	16.5
Standard deviation	62.2	249.5	37.3	10.4	17.6
Maximum	360.4	4159.9	211.7	153.8	108.7
Minimum	11.2	2.8	5.5	1.1	1.9

Table 4-10: Micro-pore diameter statistics, by type:

Micro-pore diameter (μm)	I	II	III	IV	V
Average	2.23	2.21	2.51	2.19	1.76
Median	1.18	1.05	1.11	1.13	1.07
Standard deviation	3.42	4.12	4.36	3.72	2.27
Maximum	55.54	71.85	63.79	69.38	71.17
Minimum	0.60	0.60	0.60	0.60	0.60

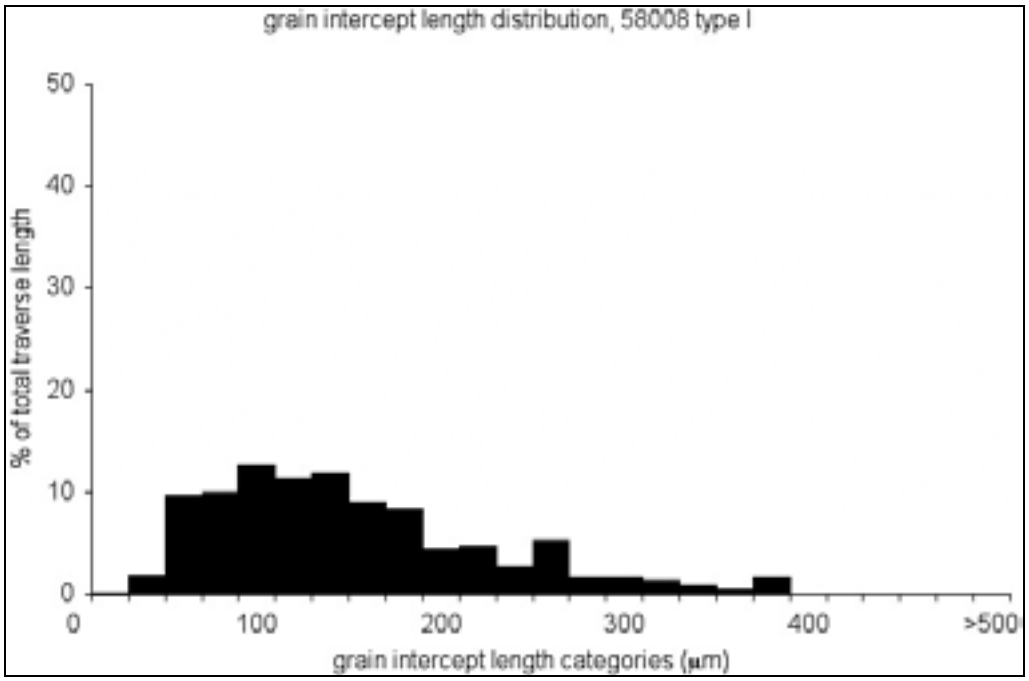


Figure 4-8a: Grain intercept length distribution from petrographic microscope traverse, Type I.

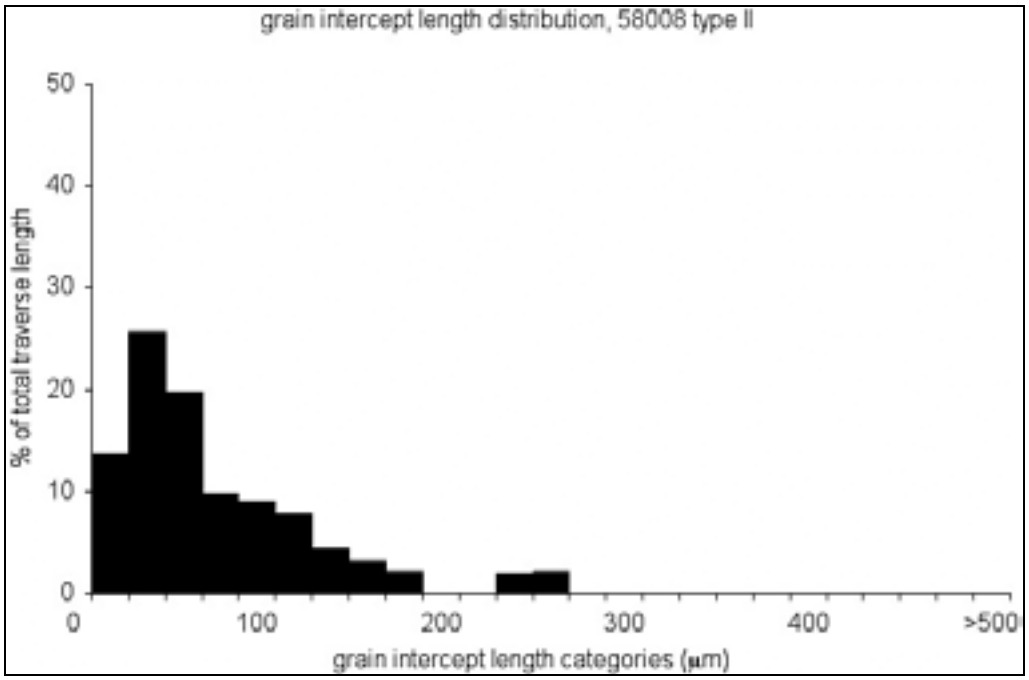


Figure 4-8b: Grain intercept length distribution from petrographic microscope traverse, Type II.

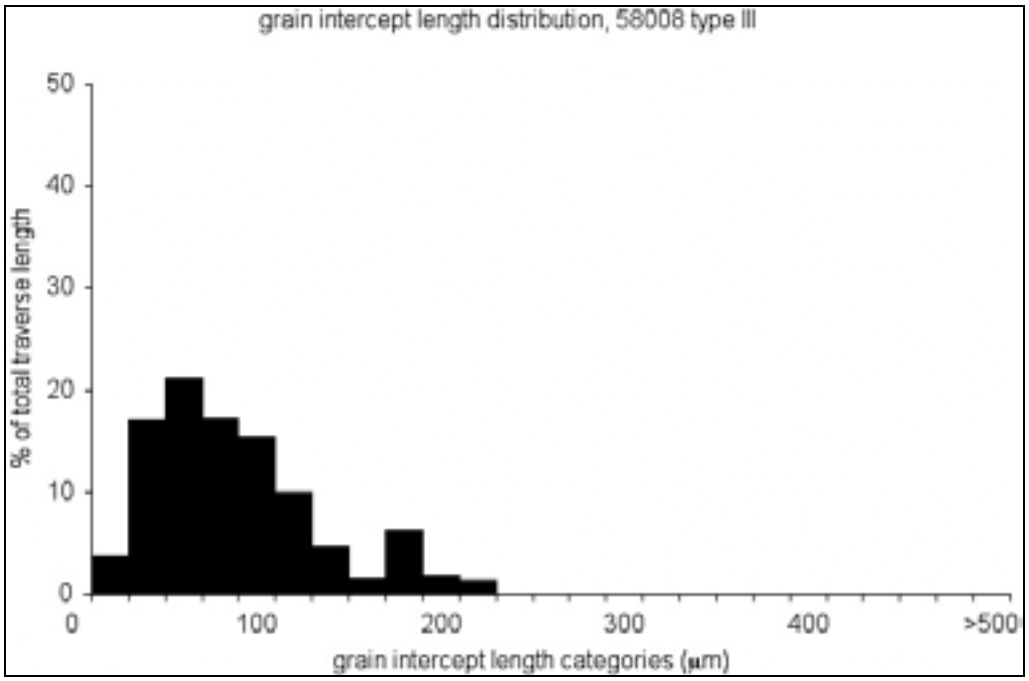


Figure 4-8c: Grain intercept length distribution from petrographic microscope traverse, Type III.

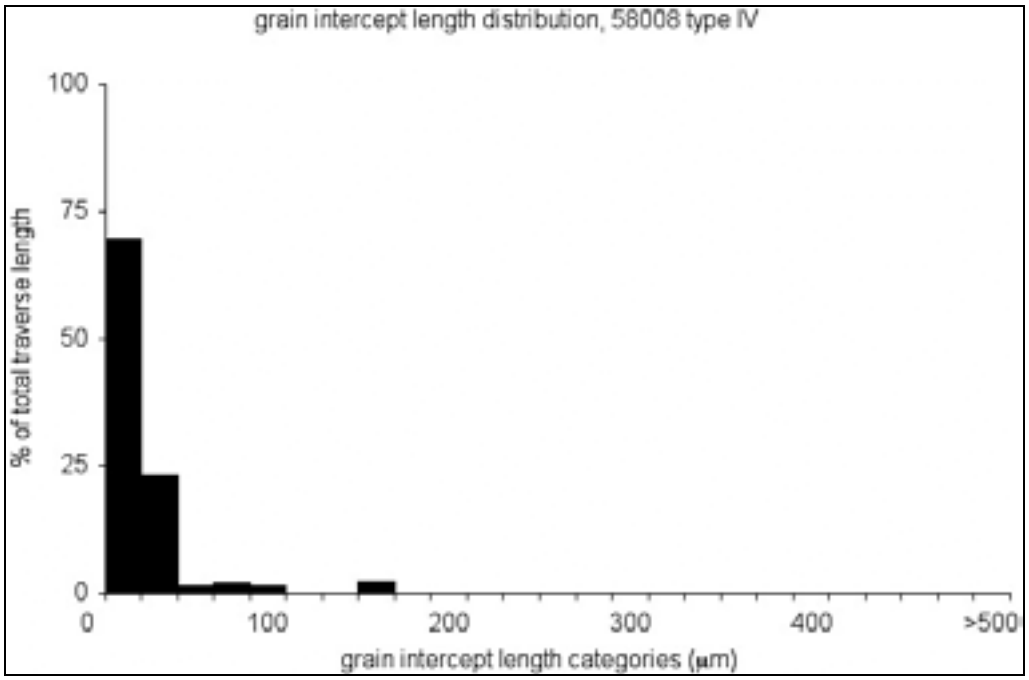


Figure 4-8d: Grain intercept length distribution from petrographic microscope traverse, Type IV.

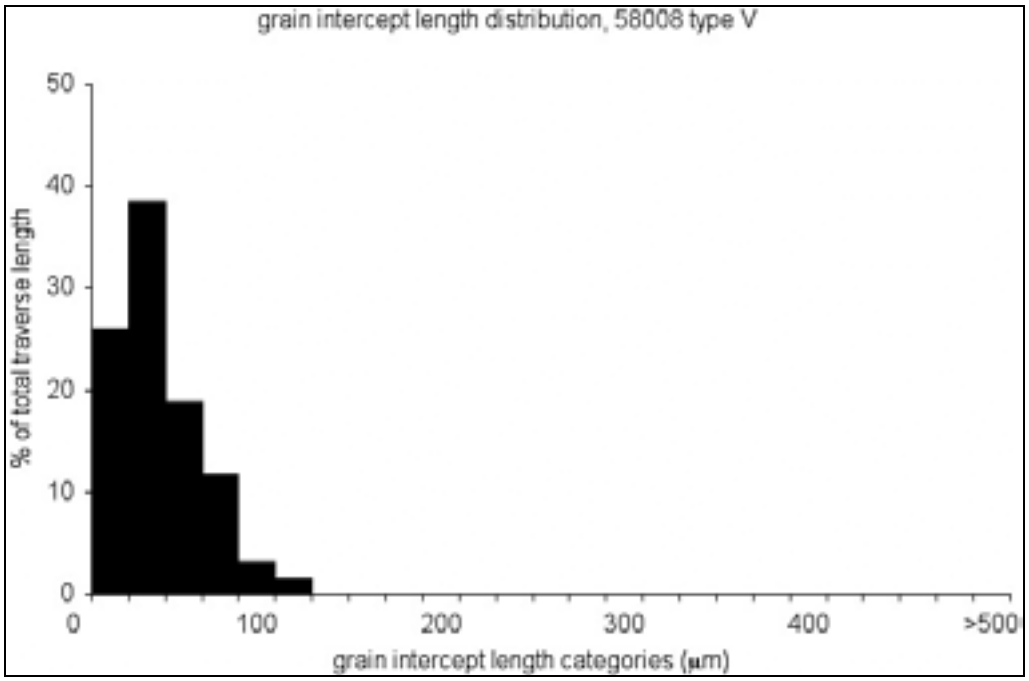


Figure 4-8e: Grain intercept length distribution from petrographic microscope traverse, Type V.

Table 4-11a: Data for grain intercept length distribution plot shown in Figure 4-8a, (type I):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	0.21	0.21
20 to <40	1.81	2.03
40 to <60	9.61	11.64
60 to <80	9.93	21.56
80 to <100	12.75	34.31
100 to <120	11.40	45.71
120 to <140	11.86	57.57
140 to <160	9.13	66.70
160 to <180	8.26	74.96
180 to <200	4.31	79.27
200 to <220	4.75	84.02
220 to <240	2.78	86.80
240 to <280	5.32	92.12
280 to <300	1.65	93.77
300 to <320	1.73	95.50
320 to <340	1.39	96.89
340 to <360	0.98	97.87
360 to <380	0.51	98.38
380 to <400	1.62	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 4-11b: Data for grain intercept length distribution plot shown in Figure 4-8b, (type II):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	13.70	13.70
20 to <40	25.70	39.41
40 to <60	19.86	59.26
60 to <80	9.86	69.13
80 to <100	9.12	78.25
100 to <120	7.93	86.17
120 to <140	4.43	90.60
140 to <160	3.19	93.79
160 to <180	2.11	95.91
180 to <200	0.00	95.91
200 to <220	0.00	95.91
220 to <240	2.00	97.90
240 to <280	2.10	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 4-11c: Data for grain intercept length distribution plot shown in Figure 4-8c, (type III):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	3.75	3.75
20 to <40	17.02	20.76
40 to <60	21.14	41.91
60 to <80	17.25	59.15
80 to <100	15.44	74.59
100 to <120	9.93	84.53
120 to <140	4.67	89.20
140 to <160	1.46	90.65
160 to <180	6.14	96.79
180 to <200	1.86	98.65
200 to <220	1.35	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 4-11d: Data for grain intercept length distribution plot shown in Figure 4-8d, (type IV):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	69.35	69.35
20 to <40	23.21	92.56
40 to <60	1.61	94.17
60 to <80	1.98	96.15
80 to <100	1.47	97.62
100 to <120	0.00	97.62
120 to <140	0.00	97.62
140 to <160	2.38	100.00
160 to <180	0.00	100.00
180 to <200	0.00	100.00
200 to <220	0.00	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 4-11e: Data for grain intercept length distribution plot shown in Figure 4-8e, (type V):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	26.02	26.02
20 to <40	38.58	64.60
40 to <60	18.81	83.41
60 to <80	11.82	95.23
80 to <100	3.21	98.45
100 to <120	1.55	100.00
120 to <140	0.00	100.00
140 to <160	0.00	100.00
160 to <180	0.00	100.00
180 to <200	0.00	100.00
200 to <220	0.00	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

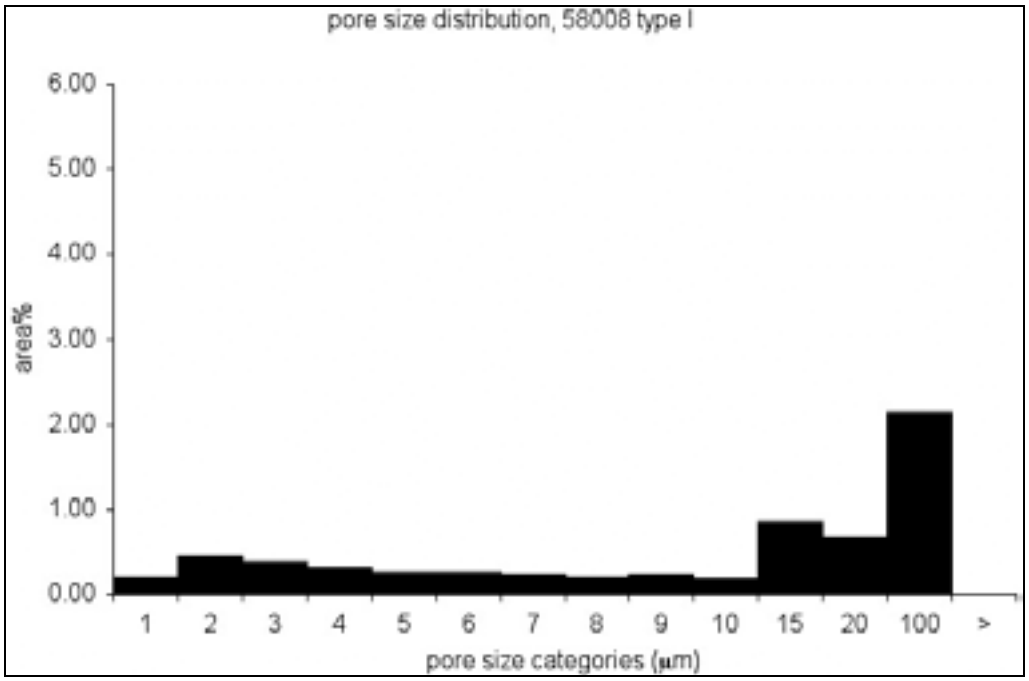


Figure 4-9a: Micro-pore size distribution from back-scattered electron images, type I.

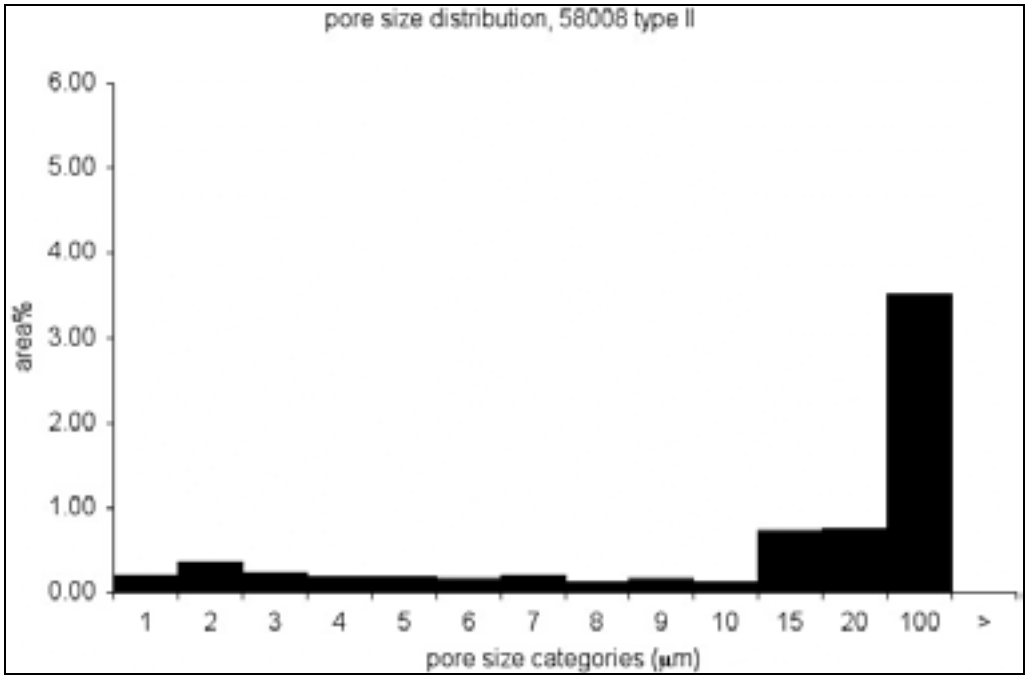


Figure 4-9b: Micro-pore size distribution from back-scattered electron images, type II.

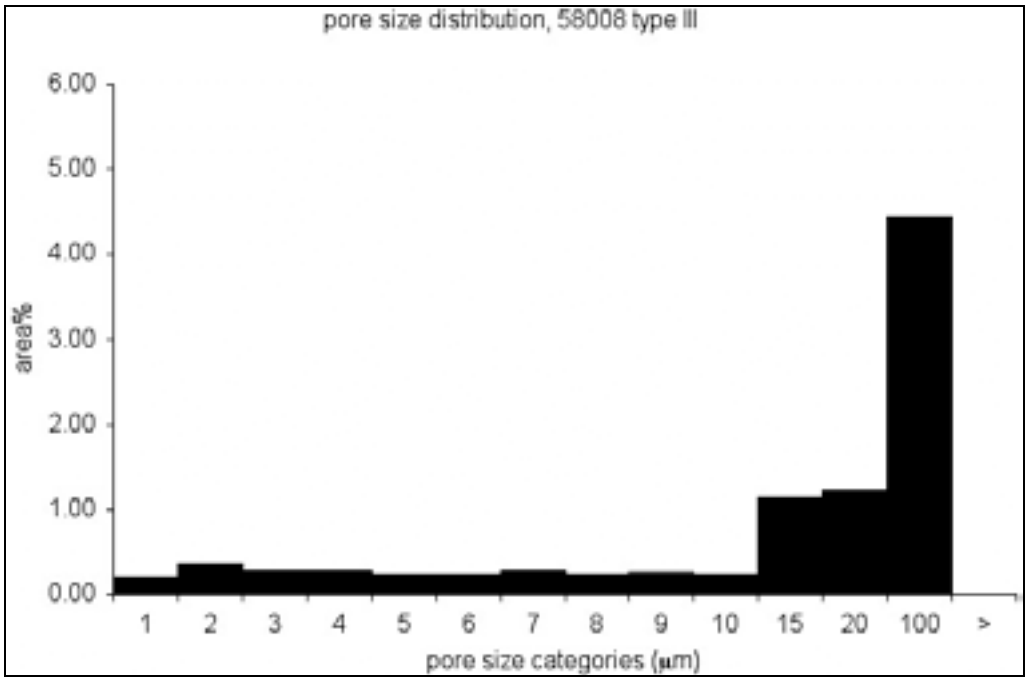


Figure 4-9c: Micro-pore size distribution from back-scattered electron images, type III.

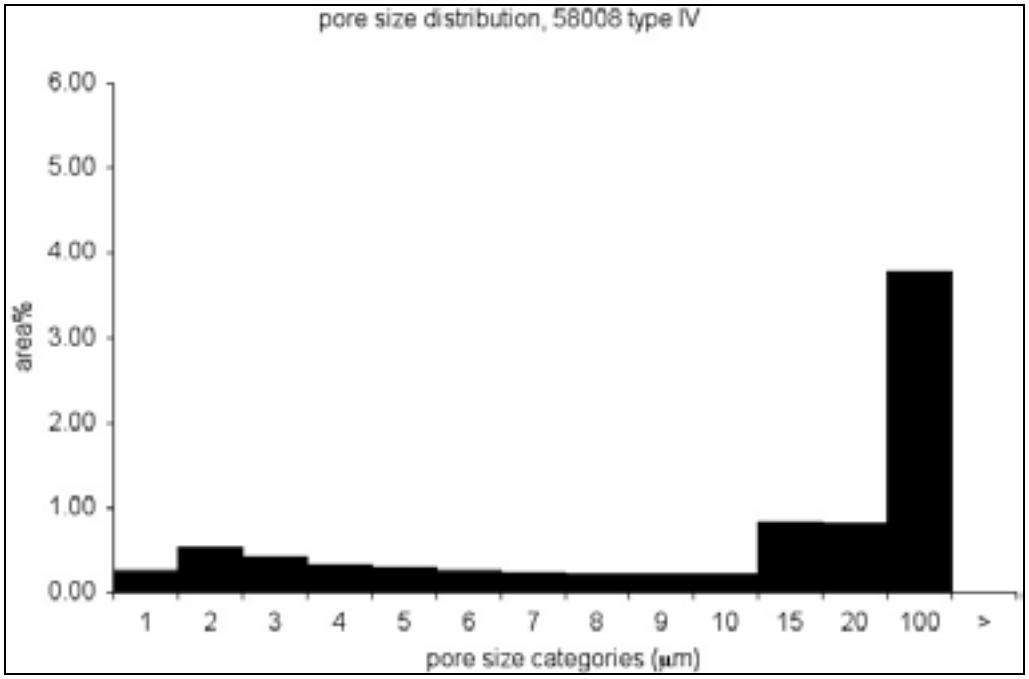


Figure 4-9d: Micro-pore size distribution from back-scattered electron images, type IV.

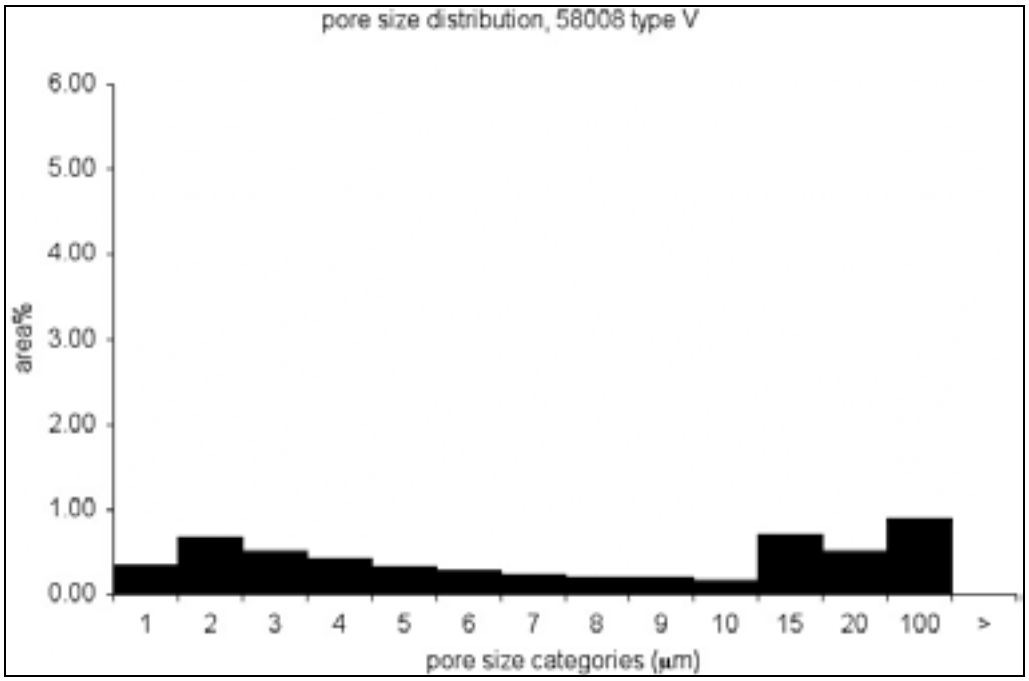


Figure 4-9e: Micro-pore size distribution from back-scattered electron images, type V.

Table 4-12a: Data for micro-pore size distribution plot shown in Figure 4-9a, (type I).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.21	3.24
1 to <2	0.46	10.41
2 to <3	0.38	16.43
3 to <4	0.31	21.26
4 to <5	0.26	25.28
5 to <6	0.26	29.33
6 to <7	0.24	33.11
7 to <8	0.20	36.23
8 to <9	0.23	39.83
9 to <10	0.18	42.64
10 to <15	0.86	56.05
15 to <20	0.68	66.62
20 to <100	2.13	100.00
100 and >	0.00	100.00
sum	6.40	

Table 4-12b: Data for micro-pore size distribution plot shown in Figure 4-9b, (type II).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.20	2.85
1 to <2	0.37	8.17
2 to <3	0.24	11.58
3 to <4	0.19	14.29
4 to <5	0.18	16.83
5 to <6	0.16	19.08
6 to <7	0.21	22.07
7 to <8	0.13	23.99
8 to <9	0.17	26.45
9 to <10	0.13	28.37
10 to <15	0.72	38.77
15 to <20	0.74	49.43
20 to <100	3.52	100.00
100 and >	0.00	100.00
sum	6.95	

Table 4-12c: Data for micro-pore size distribution plot shown in Figure 4-9c, (type III).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.20	2.16
1 to <2	0.37	6.08
2 to <3	0.27	8.96
3 to <4	0.28	11.91
4 to <5	0.23	14.41
5 to <6	0.24	16.98
6 to <7	0.27	19.89
7 to <8	0.23	22.31
8 to <9	0.24	24.93
9 to <10	0.23	27.36
10 to <15	1.14	39.55
15 to <20	1.21	52.52
20 to <100	4.44	100.00
100 and >	0.00	100.00
sum	9.36	

Table 4-12d: Data for micro-pore size distribution plot shown in Figure 4-9d, (type IV).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.25	3.02
1 to <2	0.53	9.39
2 to <3	0.41	14.26
3 to <4	0.33	18.22
4 to <5	0.28	21.62
5 to <6	0.24	24.54
6 to <7	0.23	27.32
7 to <8	0.21	29.86
8 to <9	0.22	32.47
9 to <10	0.22	35.07
10 to <15	0.83	44.92
15 to <20	0.82	54.68
20 to <100	3.80	100.00
100 and >	0.00	100.00
sum	8.38	

Table 4-12e: Data for micro-pore size distribution plot shown in Figure 4-9e, (type V).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.34	6.26
1 to <2	0.67	18.67
2 to <3	0.50	27.96
3 to <4	0.41	35.52
4 to <5	0.33	41.60
5 to <6	0.28	46.75
6 to <7	0.24	51.20
7 to <8	0.20	54.89
8 to <9	0.19	58.43
9 to <10	0.16	61.45
10 to <15	0.70	74.38
15 to <20	0.50	83.64
20 to <100	0.89	100.00
100 and >	0.00	100.00
sum	5.42	

Table 4-13: Coefficient of thermal expansion, by type:

Type	Coefficient of thermal expansion (mm/mm/degree C):
I	7.62E-06
II	7.62E-06
III	7.62E-06
IV	8.34E-06
V	8.34E-06

58009 - Denniston

Table 5- 1: Pit name, location, and general geologic information:

Pit Number	58009
Name	Denniston
Longitude	-83.44
Latitude	41.89
Era	Palaeozoic
Period	Devonian
Group	Basswood Island
Member	
Rock Type	dolomite
Description	Tan to gray, brown, dark brown to gray fine to medium grained dolomite.

Table 5- 2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	8.311E-06
Bulk specific gravity (oven dry)	2.62
Bulk specific gravity (saturated surface dry)	2.68
Apparent specific gravity	2.79
Absorption %	2.34
Average grain intercept length (µm)	51.8
Area % micro-pores	22.23
Average micro-pore diameter (µm)	2.07

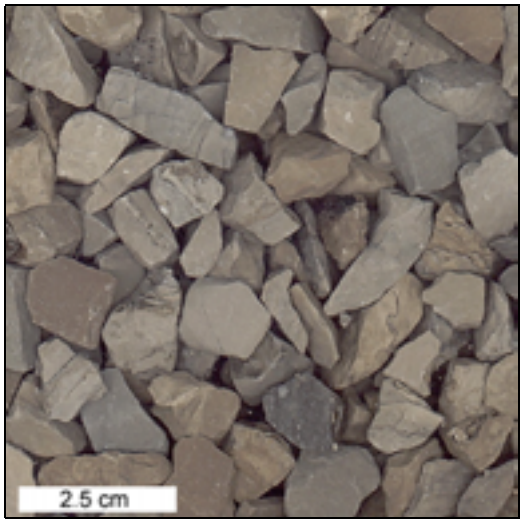


Figure 5-1: Photo of 3/8" sieve fraction of 6AA product.

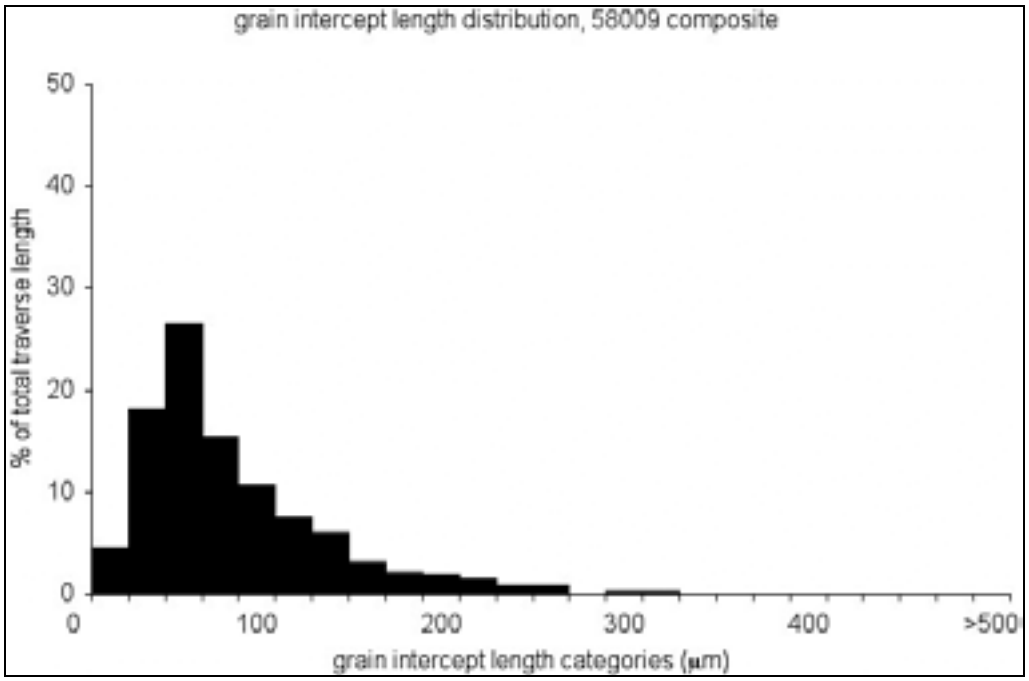


Figure 5-2: Grain intercept length distribution from petrographic microscope traverse.

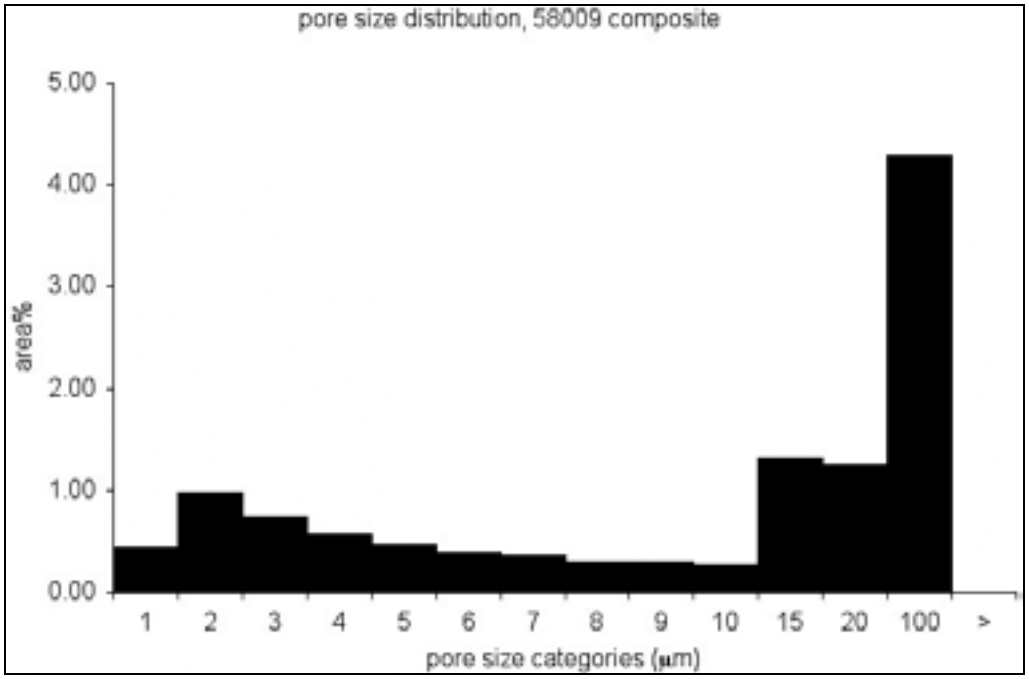


Figure 5-3: Micro-pore size distribution from back-scattered electron images.

Table 5- 3: Data for grain intercept length distribution plot shown in Figure 5-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	4.47	4.47
20 to <40	18.10	22.57
40 to <60	26.63	49.20
60 to <80	15.40	64.60
80 to <100	10.77	75.37
100 to <120	7.51	82.87
120 to <140	6.05	88.92
140 to <160	3.15	92.07
160 to <180	2.10	94.17
180 to <200	1.90	96.07
200 to <220	1.45	97.52
220 to <240	0.96	98.48
240 to <280	0.90	99.38
280 to <300	0.00	99.38
300 to <320	0.30	99.68
320 to <340	0.32	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 5- 4: Data for micro-pore size distribution plot shown in Figure 5-3.

Size categories (μm)	Area %	Cumulative %
0 to <1	0.43	3.71
1 to <2	0.98	12.13
2 to <3	0.74	18.44
3 to <4	0.57	23.30
4 to <5	0.47	27.28
5 to <6	0.40	30.68
6 to <7	0.37	33.82
7 to <8	0.30	36.42
8 to <9	0.30	39.01
9 to <10	0.27	41.29
10 to <15	1.32	52.58
15 to <20	1.26	63.35
20 to <100	4.29	100.00
100 and >	0.00	100.00
sum	11.69	

Table 5- 5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	20.63
Al_2O_3	0.56
SiO_2	3.26
S	0.12
CaO	29.10
Fe_2O_3	0.37
sum	54.04

Table 5- 6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	94.37
Calcite - $CaCO_3$	0.72
Pyrite - FeS_2	0.22
Other	3.26
sum	98.57

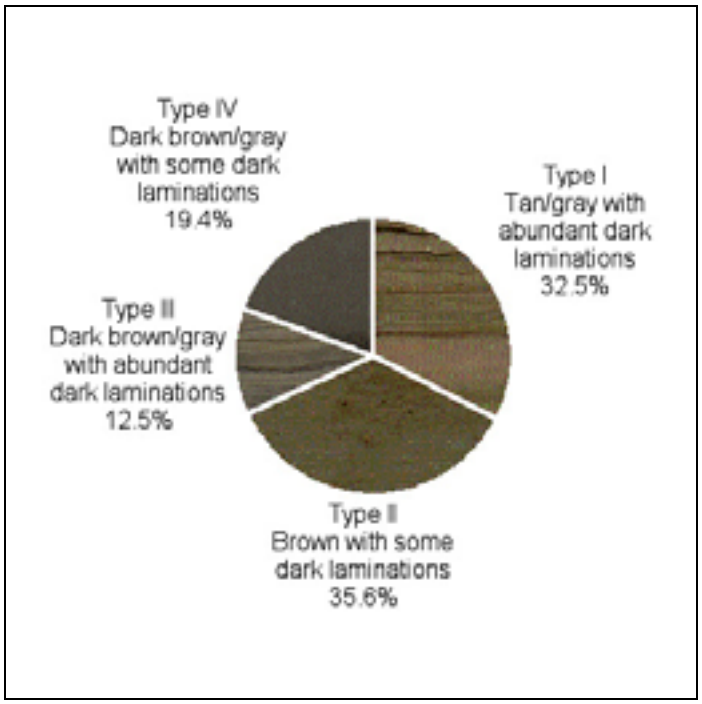


Figure 5-4: Rock types within aggregate source based on differences in color and texture.

Table 5- 7: Composition as determined by x-ray fluorescence, by type:

Oxide/element wt%	I	II	III	IV
MgO	20.77	20.95	20.23	20.07
Al_2O_3	0.47	0.17	0.73	1.23
SiO_2	2.86	1.70	4.82	5.25
S	0.11	0.07	0.12	0.20
CaO	29.30	30.19	28.40	27.77
Fe_2O_3	0.37	0.29	0.47	0.61
sum	53.88	53.37	54.77	55.13

Table 5- 8: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral wt%	I	II	III	IV
Dolomite - $Ca,Mg(CO_3)_2$	95.03	95.85	92.54	91.33
Calcite - $CaCO_3$	0.71	1.85	0.46	0.00
Pyrite - FeS_2	0.20	0.13	0.23	0.37
Other	2.86	1.70	4.82	5.25
sum	98.80	99.53	98.05	96.94

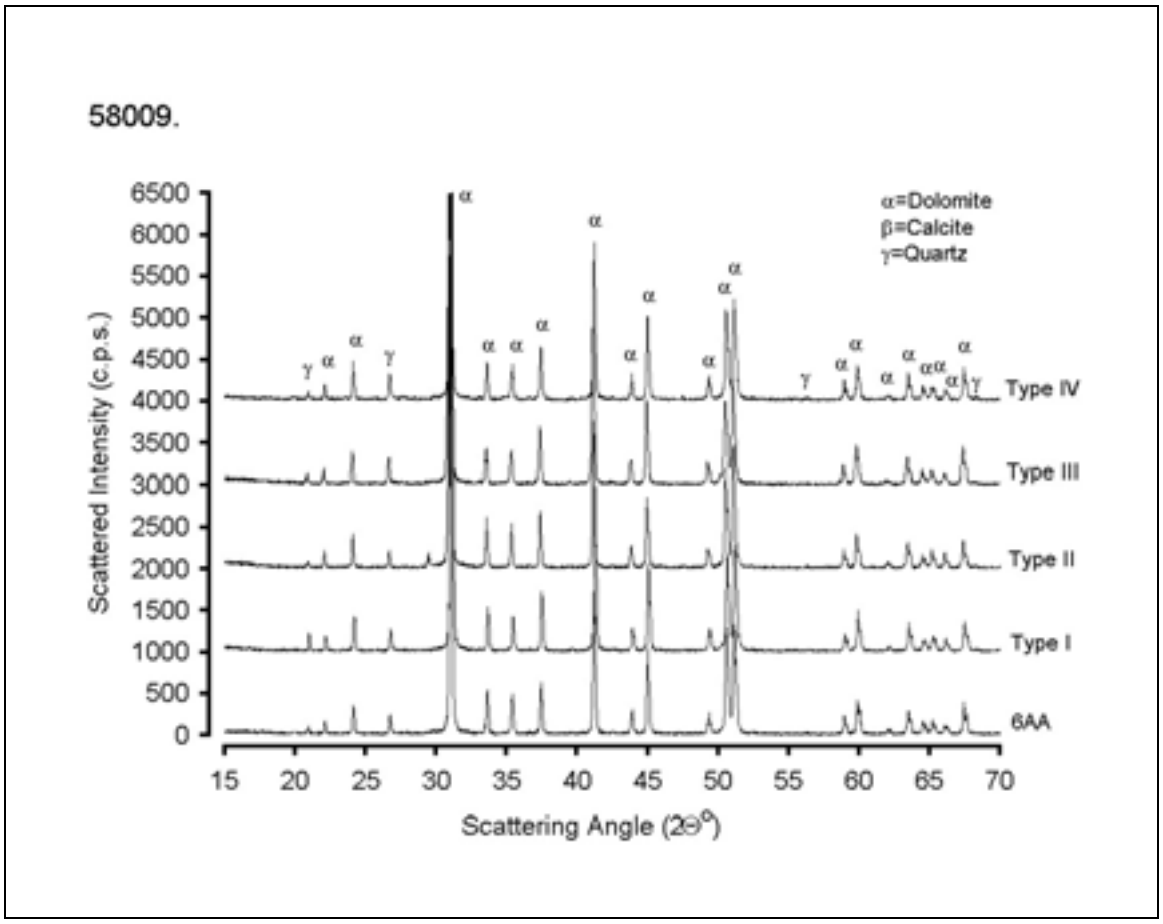


Figure 5-5: X-ray diffraction pattern from aggregate source.

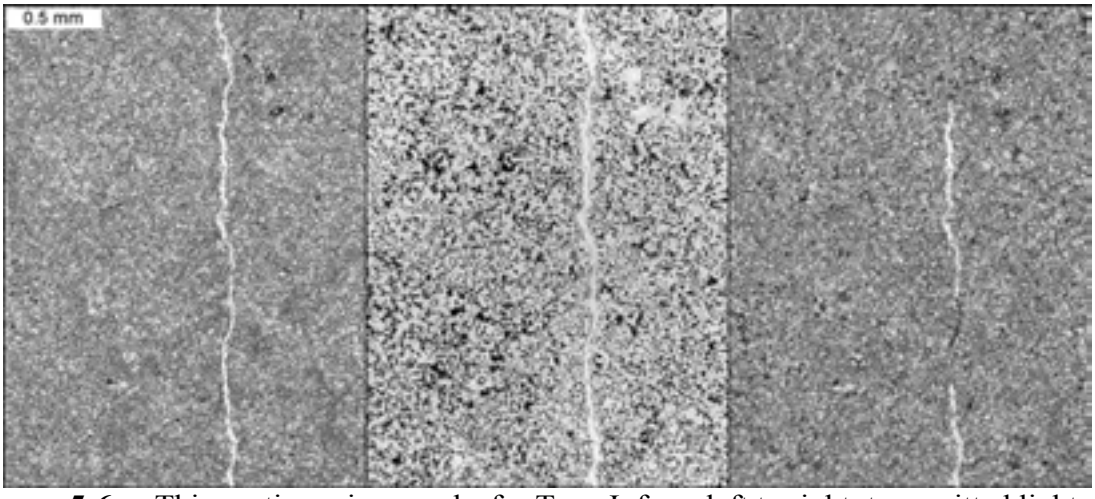


Figure 5-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

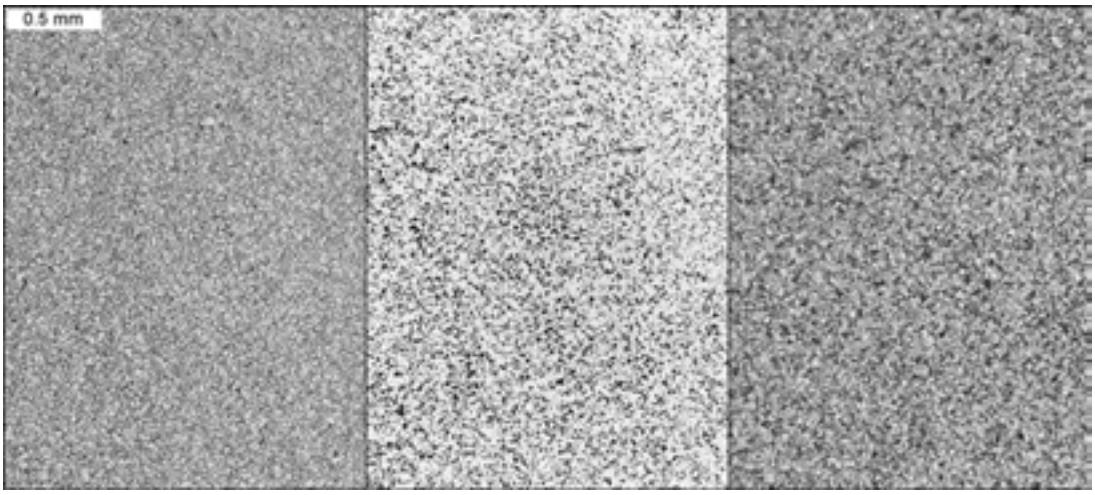


Figure 5-6b: Thin section micrographs for Type II, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

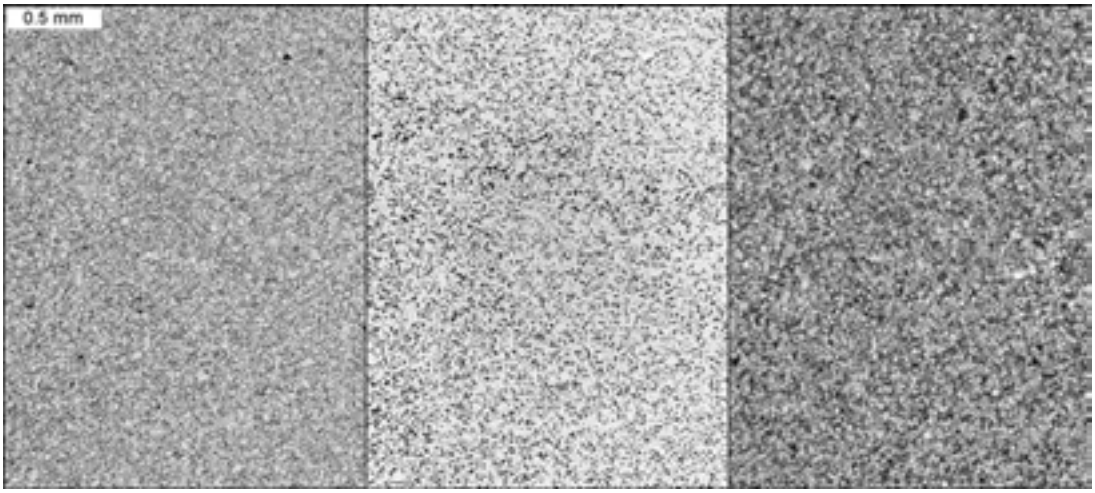


Figure 5-6c: Thin section micrographs for Type III, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

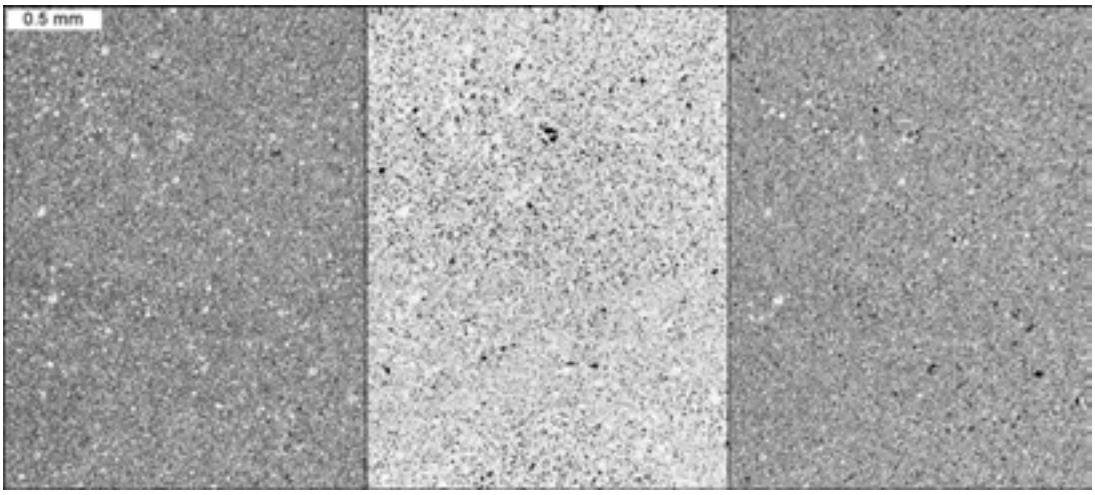


Figure 5-6d: Thin section micrographs for Type IV, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

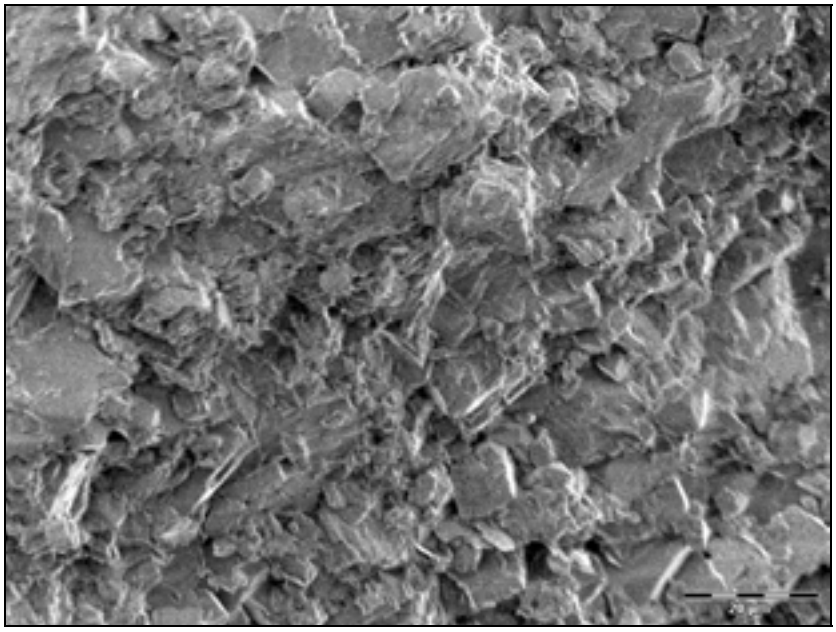


Figure 5-7a: ESEM photo of fracture surface for type I.

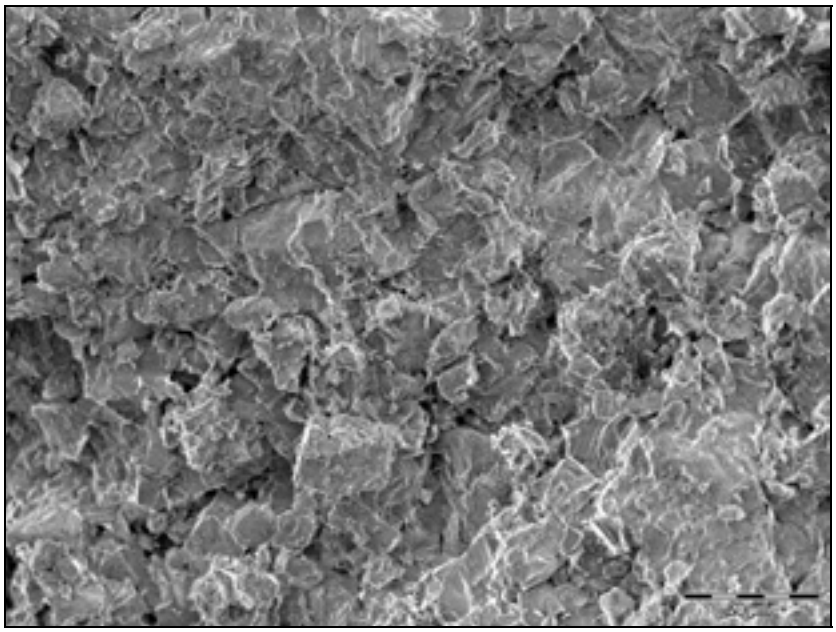


Figure 5-7b: ESEM photo of fracture surface for type II.

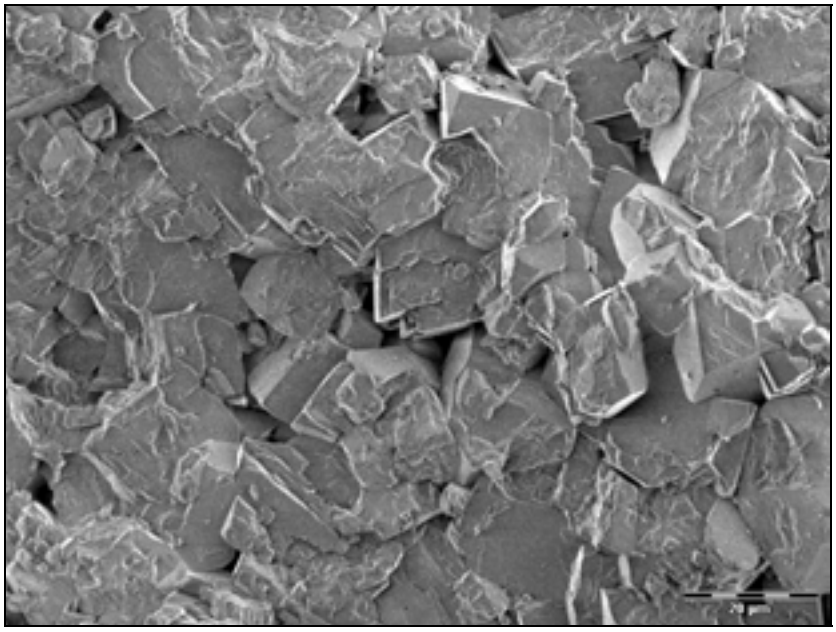


Figure 5-7c: ESEM photo of fracture surface for type III.

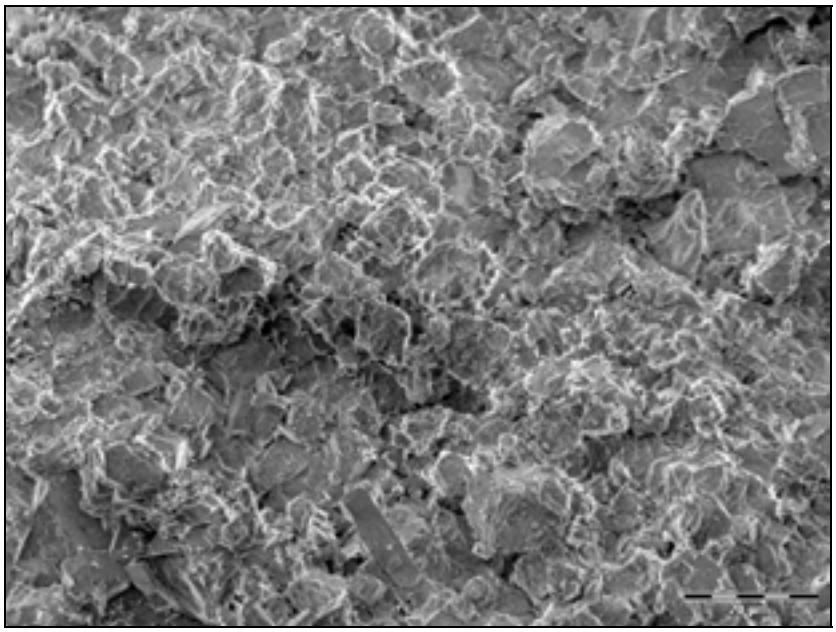


Figure 5-7d: ESEM photo of fracture surface for type IV.

Table 5-9: Grain intercept length statistics, by type:

Grain intercept length (μm)	I	II	III	IV
Average	43.5	62.5	52.7	45.4
Median	36.6	48.3	44.4	40.5
Standard deviation	31.0	46.0	36.4	27.0
Maximum	242.9	309.0	242.9	168.9
Minimum	13.3	5.5	5.5	13.3

Table 5-10: Micro-pore diameter statistics, by type:

Micro-pore diameter (μm)	I	II	III	IV
Average	1.99	2.21	2.08	1.96
Median	1.12	1.05	1.22	1.18
Standard deviation	3.26	4.12	3.07	2.61
Maximum	81.78	71.85	68.89	56.75
Minimum	0.60	0.60	0.60	0.60

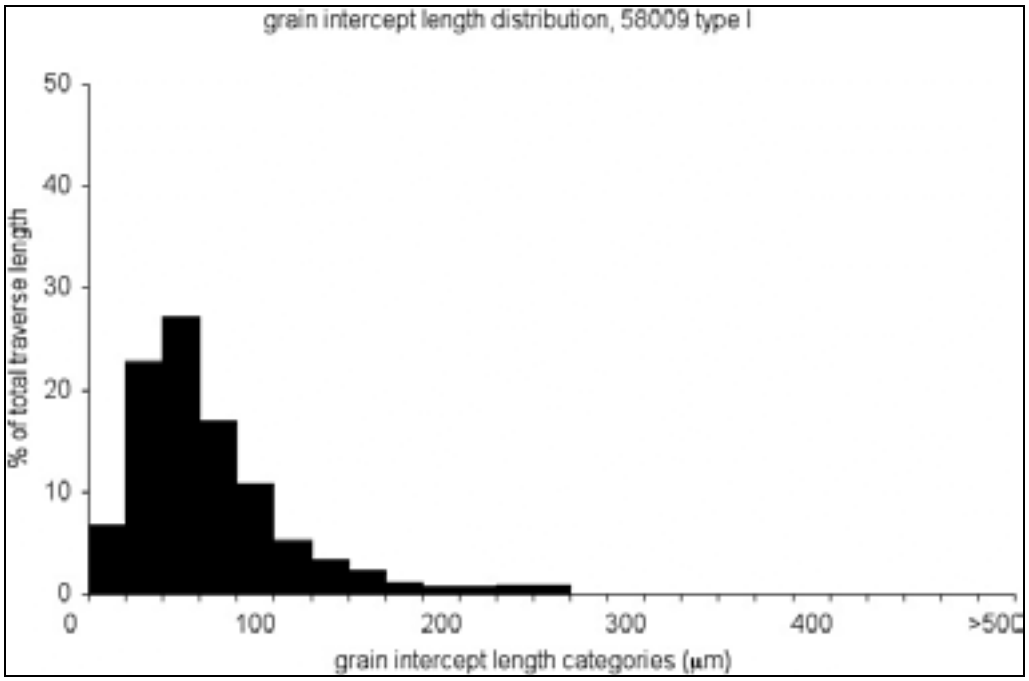


Figure 5-8a: Grain intercept length distribution from petrographic microscope traverse, Type I.

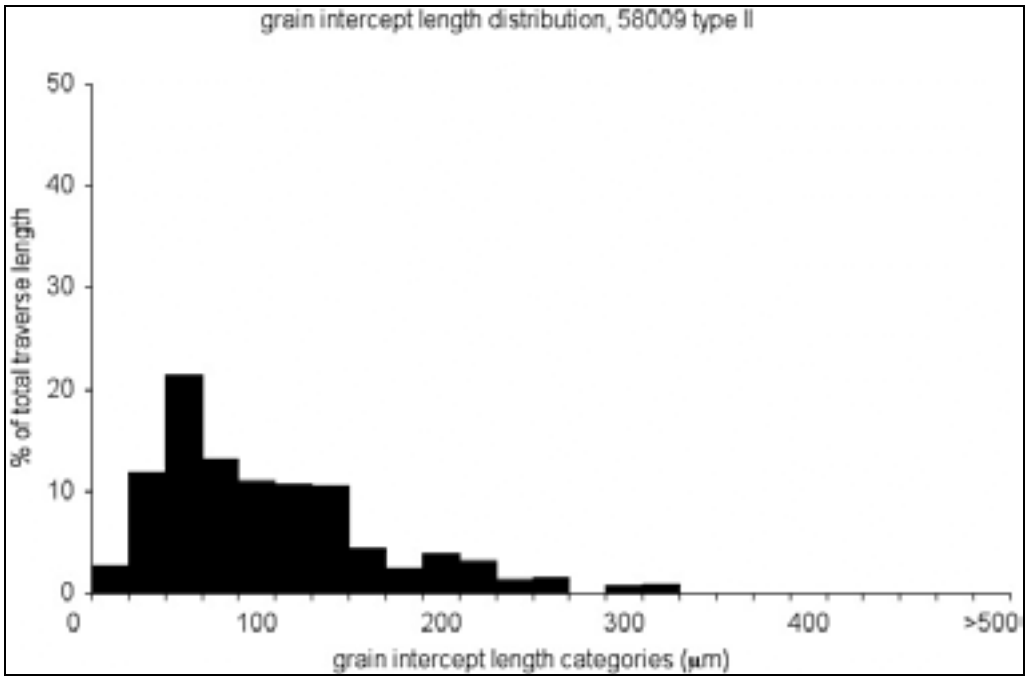


Figure 5-8b: Grain intercept length distribution from petrographic microscope traverse, Type II.

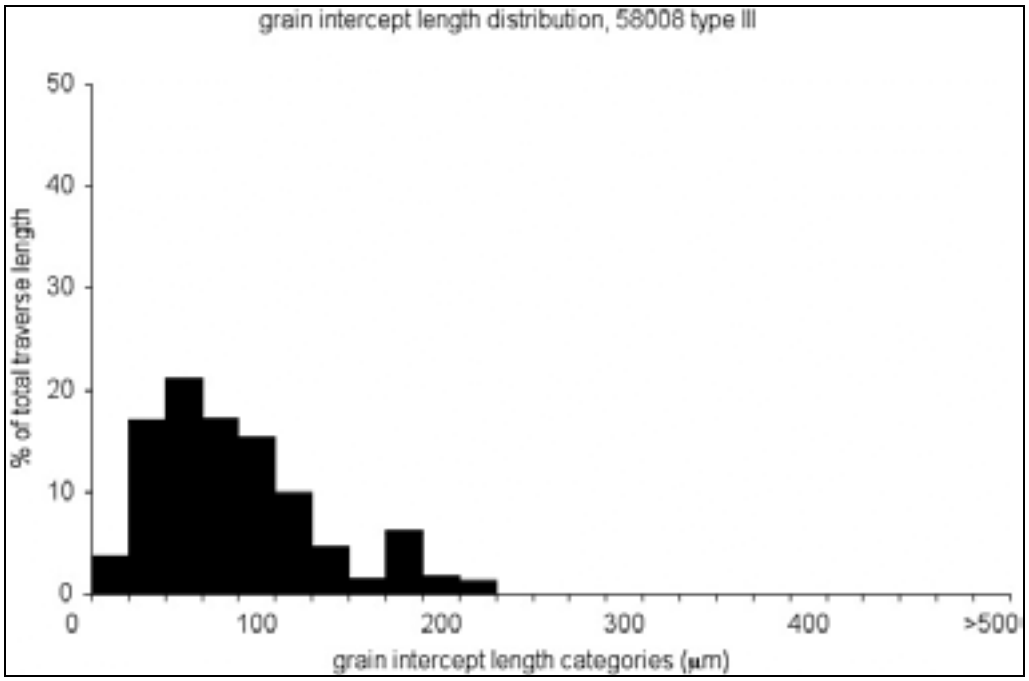


Figure 5-8c: Grain intercept length distribution from petrographic microscope traverse, Type III.

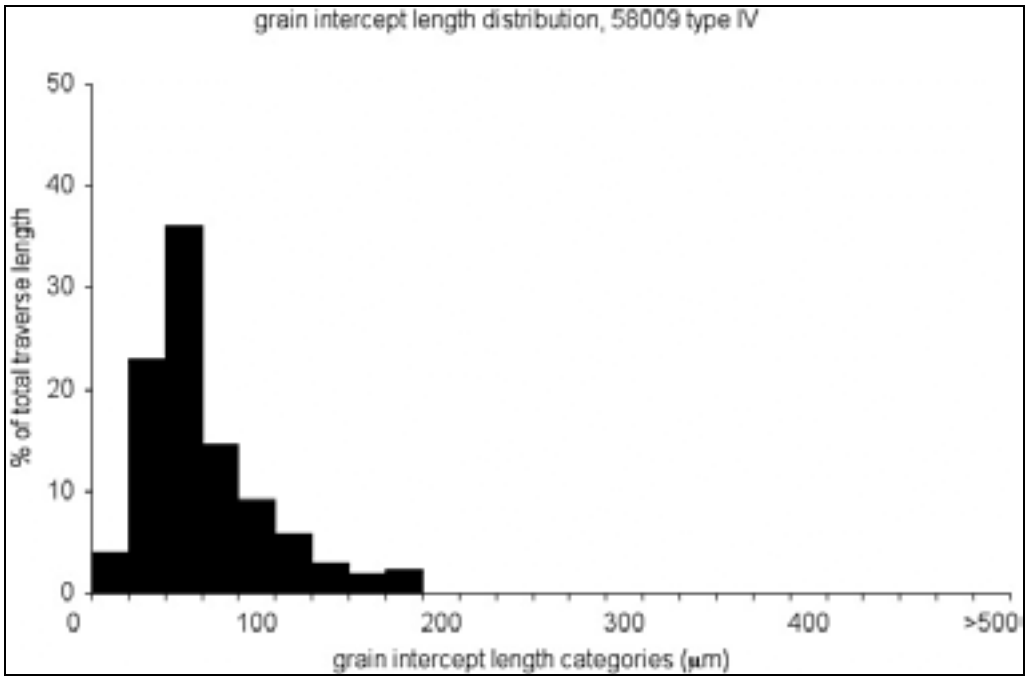


Figure 5-8d: Grain intercept length distribution from petrographic microscope traverse, Type IV.

Table 5-11a: Data for grain intercept length distribution plot shown in Figure 5-8a, (type I):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	6.79	6.79
20 to <40	22.77	29.55
40 to <60	27.24	56.79
60 to <80	16.95	73.74
80 to <100	10.83	84.57
100 to <120	5.32	89.89
120 to <140	3.35	93.24
140 to <160	2.25	95.49
160 to <180	1.25	96.74
180 to <200	0.72	97.46
200 to <220	0.78	98.24
220 to <240	0.85	99.09
240 to <280	0.91	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 5-11b: Data for grain intercept length distribution plot shown in Figure 5-8b, (type II):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	2.75	2.75
20 to <40	11.88	14.62
40 to <60	21.44	36.06
60 to <80	13.16	49.22
80 to <100	11.01	60.23
100 to <120	10.78	71.01
120 to <140	10.59	81.60
140 to <160	4.40	86.00
160 to <180	2.45	88.45
180 to <200	3.86	92.31
200 to <220	3.13	95.44
220 to <240	1.38	96.82
240 to <280	1.44	98.26
280 to <300	0.00	98.26
300 to <320	0.83	99.09
320 to <340	0.91	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 5-11c: Data for grain intercept length distribution plot shown in Figure 5-8c, (type III):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	4.06	4.06
20 to <40	16.09	20.15
40 to <60	25.06	45.21
60 to <80	18.87	64.08
80 to <100	12.30	76.38
100 to <120	6.48	82.86
120 to <140	4.95	87.81
140 to <160	3.76	91.57
160 to <180	3.14	94.71
180 to <200	2.35	97.07
200 to <220	0.67	97.74
220 to <240	1.49	99.23
240 to <280	0.77	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 5-11d: Data for grain intercept length distribution plot shown in Figure 5-8d, (type IV):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	4.01	4.01
20 to <40	23.01	27.01
40 to <60	36.15	63.16
60 to <80	14.65	77.81
80 to <100	9.24	87.05
100 to <120	5.83	92.89
120 to <140	2.95	95.84
140 to <160	1.96	97.80
160 to <180	2.20	100.00
180 to <200	0.00	100.00
200 to <220	0.00	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

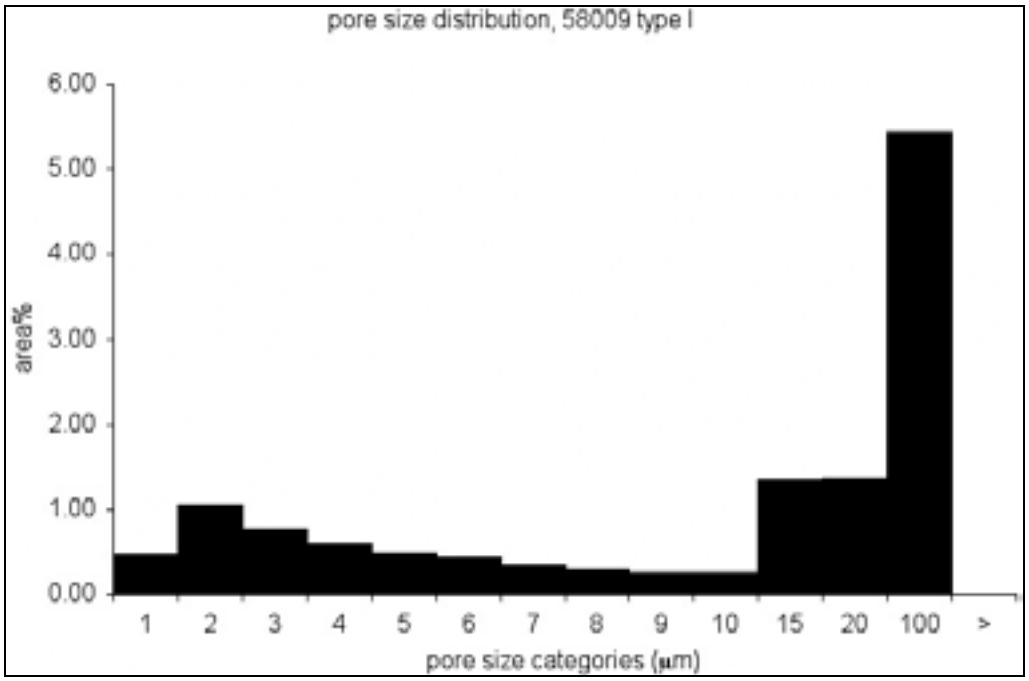


Figure 5-9a: Micro-pore size distribution from back-scattered electron images, type I.

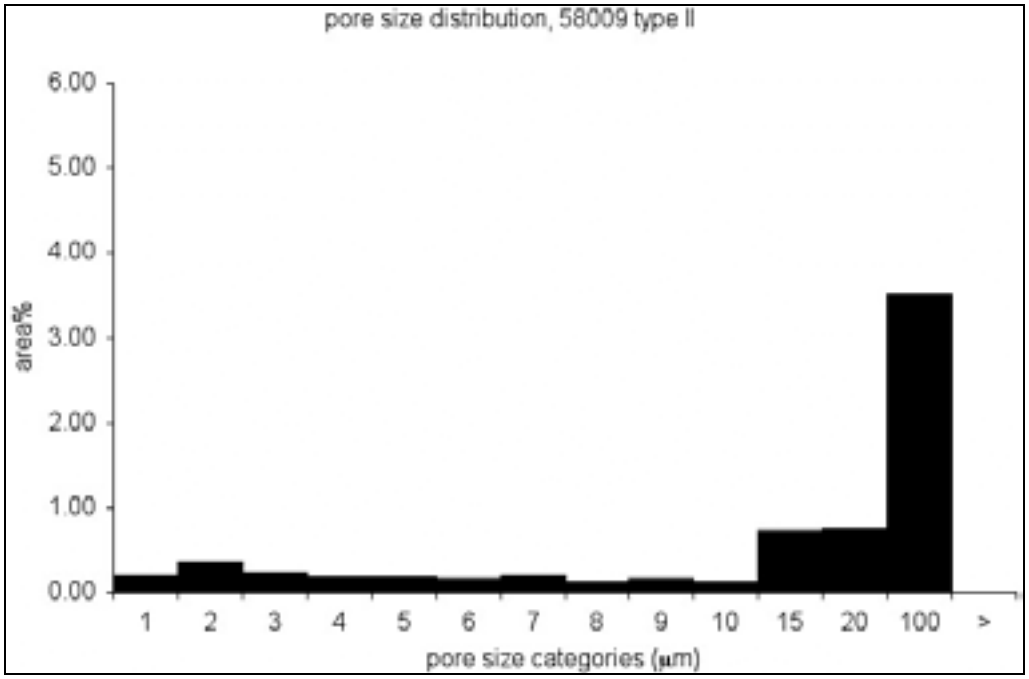


Figure 5-9b: Micro-pore size distribution from back-scattered electron images, type II.

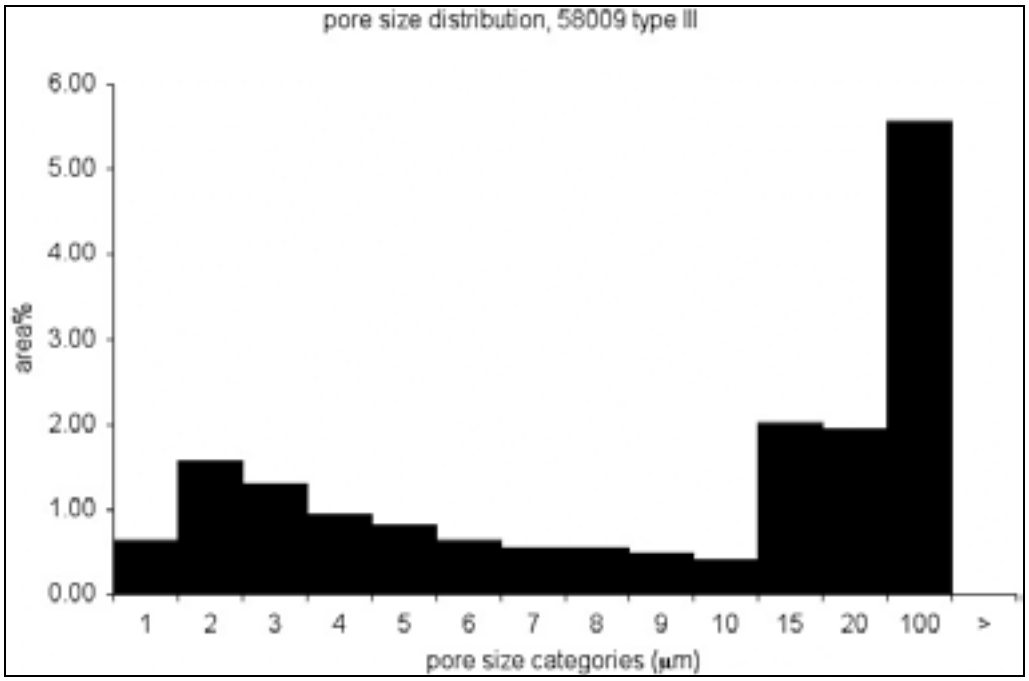


Figure 5-9c: Micro-pore size distribution from back-scattered electron images, type III.

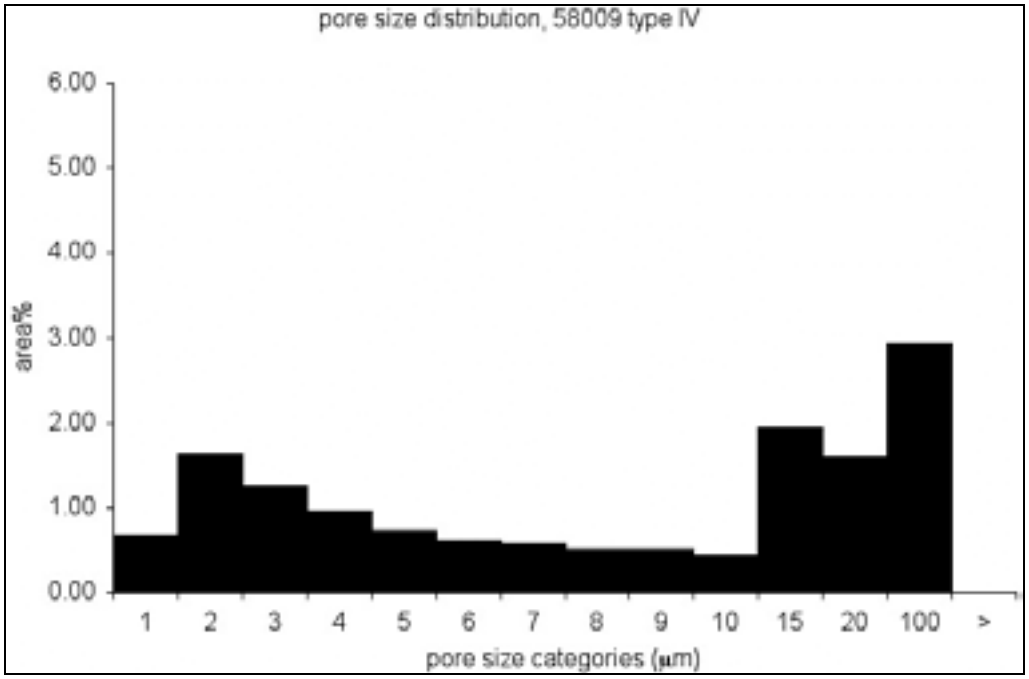


Figure 5-9d: Micro-pore size distribution from back-scattered electron images, type IV.

Table 5-12a: Data for micro-pore size distribution plot shown in Figure 5-9a, (type I).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.48	3.63
1 to <2	1.05	11.66
2 to <3	0.76	17.49
3 to <4	0.60	22.09
4 to <5	0.50	25.88
5 to <6	0.44	29.24
6 to <7	0.35	31.88
7 to <8	0.28	34.04
8 to <9	0.25	35.93
9 to <10	0.26	37.93
10 to <15	1.34	48.15
15 to <20	1.36	58.50
20 to <100	5.44	100.00
100 and >	0.00	100.00
sum	13.11	

Table 5-12b: Data for micro-pore size distribution plot shown in Figure 5-9b, (type II).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.20	2.85
1 to <2	0.37	8.17
2 to <3	0.24	11.58
3 to <4	0.19	14.29
4 to <5	0.18	16.83
5 to <6	0.16	19.08
6 to <7	0.21	22.07
7 to <8	0.13	23.99
8 to <9	0.17	26.45
9 to <10	0.13	28.37
10 to <15	0.72	38.77
15 to <20	0.74	49.43
20 to <100	3.52	100.00
100 and >	0.00	100.00
sum	6.95	

Table 5-12c: Data for micro-pore size distribution plot shown in Figure 5-9c, (type III).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.63	3.60
1 to <2	1.57	12.62
2 to <3	1.31	20.14
3 to <4	0.95	25.59
4 to <5	0.81	30.25
5 to <6	0.64	33.92
6 to <7	0.54	37.01
7 to <8	0.54	40.13
8 to <9	0.49	42.97
9 to <10	0.40	45.30
10 to <15	2.01	56.86
15 to <20	1.94	68.02
20 to <100	5.56	100.00
100 and >	0.00	100.00
sum	17.38	

Table 5-12d: Data for micro-pore size distribution plot shown in Figure 5-9d, (type IV).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.67	4.69
1 to <2	1.62	16.01
2 to <3	1.24	24.69
3 to <4	0.96	31.42
4 to <5	0.72	36.43
5 to <6	0.61	40.67
6 to <7	0.59	44.76
7 to <8	0.50	48.26
8 to <9	0.51	51.84
9 to <10	0.43	54.82
10 to <15	1.94	68.34
15 to <20	1.60	79.52
20 to <100	2.94	100.00
100 and >	0.00	100.00
sum	14.34	

Table 5-13: Coefficient of thermal expansion, by type:

Type	Coefficient of thermal expansion (mm/mm/degree C):
I	8.40E-06
II	8.19E-06
III	8.40E-06
IV	8.19E-06

58011 - Newport

Table 6-1: Pit name, location, and general geologic information:

Pit Number	58011
Name	Newport
Longitude	-83.24
Latitude	42.01
Era	Palaeozoic
Period	Devonian
Group	Basswood Island
Member	
Rock Type	dolomite
Description	Light tan to gray, tan to gray, brown, dark brown to gray fine to medium grained dolomite.

Table 6-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	7.675E-06
Bulk specific gravity (oven dry)	2.61
Bulk specific gravity (saturated surface dry)	2.67
Apparent specific gravity	2.78
Absorption %	2.36
Average grain intercept length (µm)	41.6
Area % micro-pores	13.26
Average micro-pore diameter (µm)	1.93

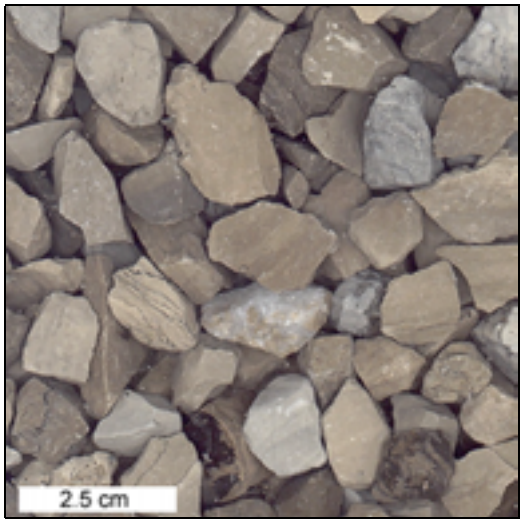


Figure 6-1: Photo of 3/8" sieve fraction of 6AA product.

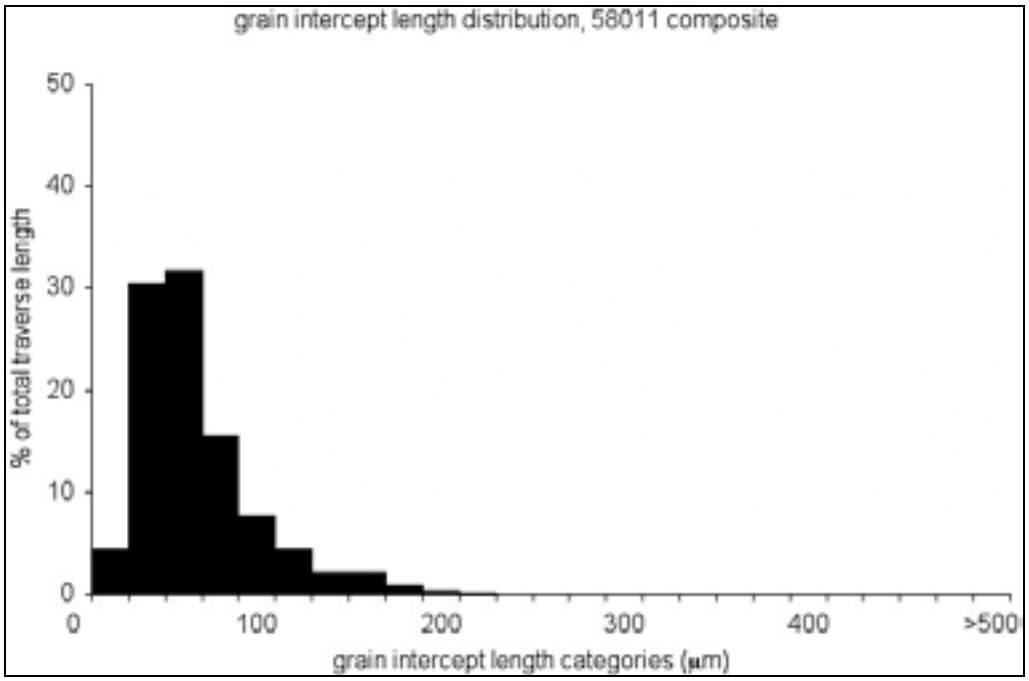


Figure 6-2: Grain intercept length distribution from petrographic microscope traverse.

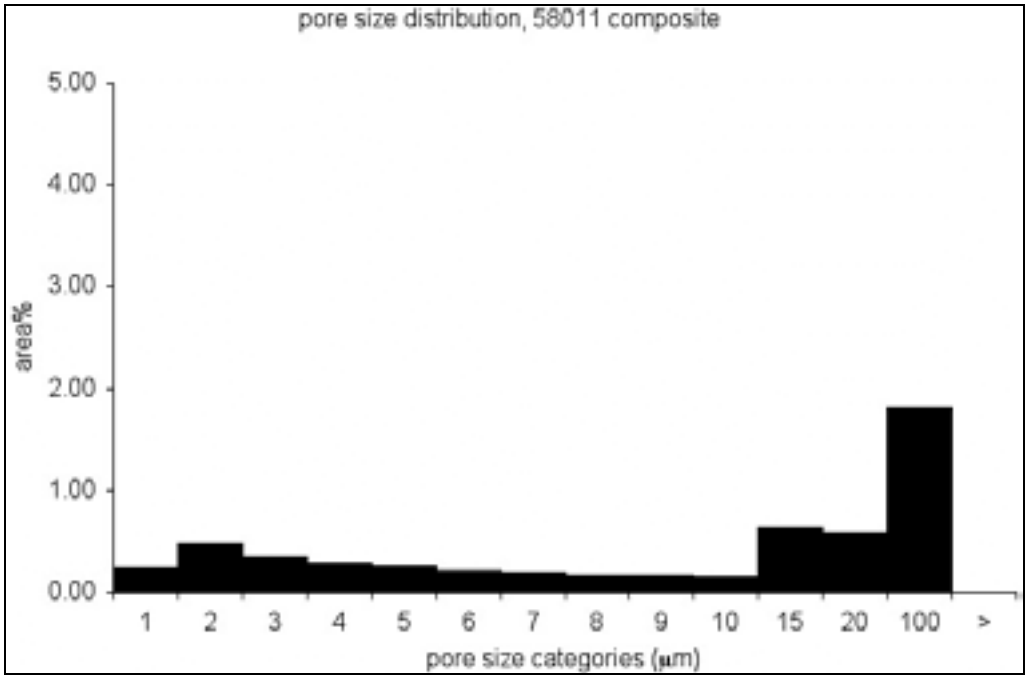


Figure 6-3: Micro-pore size distribution from back-scattered electron images.

Table 6-3: Data for grain intercept length distribution plot shown in Figure 6-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	4.35	4.35
20 to <40	30.54	34.88
40 to <60	31.75	66.64
60 to <80	15.52	82.15
80 to <100	7.69	89.84
100 to <120	4.40	94.24
120 to <140	2.18	96.42
140 to <160	2.08	98.50
160 to <180	0.93	99.43
180 to <200	0.36	99.79
200 to <220	0.17	99.96
220 to <240	0.00	99.96
240 to <280	0.04	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 6-4: Data for micro-pore size distribution plot shown in Figure 6-3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.24	4.37
1 to <2	0.48	13.00
2 to <3	0.35	19.40
3 to <4	0.29	24.68
4 to <5	0.25	29.21
5 to <6	0.22	33.17
6 to <7	0.19	36.64
7 to <8	0.17	39.63
8 to <9	0.16	42.60
9 to <10	0.15	45.30
10 to <15	0.63	56.71
15 to <20	0.59	67.36
20 to <100	1.81	100.00
100 and >	0.00	100.00
sum	5.54	

Table 6-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	20.79
Al_2O_3	0.36
SiO_2	2.50
S	0.14
CaO	29.23
Fe_2O_3	0.34
sum	53.38

Table 6-6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	95.14
Calcite - $CaCO_3$	0.54
Pyrite - FeS_2	0.27
Other	2.50
sum	98.44

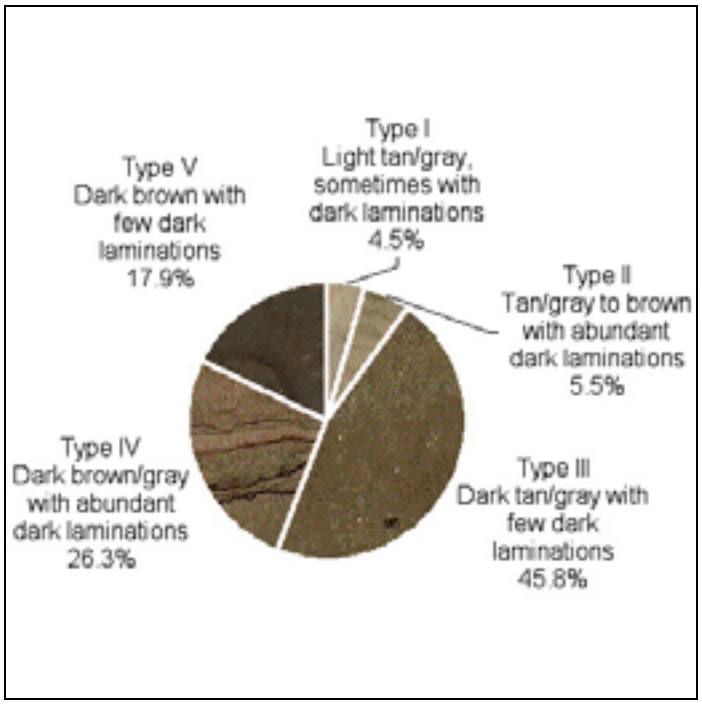


Figure 6-4: Rock types within aggregate source based on differences in color and texture.

Table 6-7: Composition as determined by x-ray fluorescence, by type:

Oxide/element wt%	I	II	III	IV	V
MgO	20.07	20.58	20.24	19.99	20.65
Al_2O_3	1.36	0.68	0.06	0.12	0.23
SiO_2	4.89	3.56	6.49	0.76	1.11
S	0.21	0.11	0.09	0.24	0.33
CaO	27.70	28.81	27.72	30.49	29.22
Fe_2O_3	0.56	0.27	1.40	0.18	0.33
sum	54.79	54.02	56.00	51.78	51.88

Table 6-8: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral wt%	I	II	III	IV	V
Dolomite - $Ca,Mg(CO_3)_2$	91.10	94.16	91.15	91.44	94.46
Calcite - $CaCO_3$	0.00	0.32	0.00	4.78	0.88
Pyrite - FeS_2	0.40	0.21	0.18	0.46	0.62
Other	4.89	3.56	6.49	0.76	1.11
sum	96.39	98.25	97.82	97.44	97.08

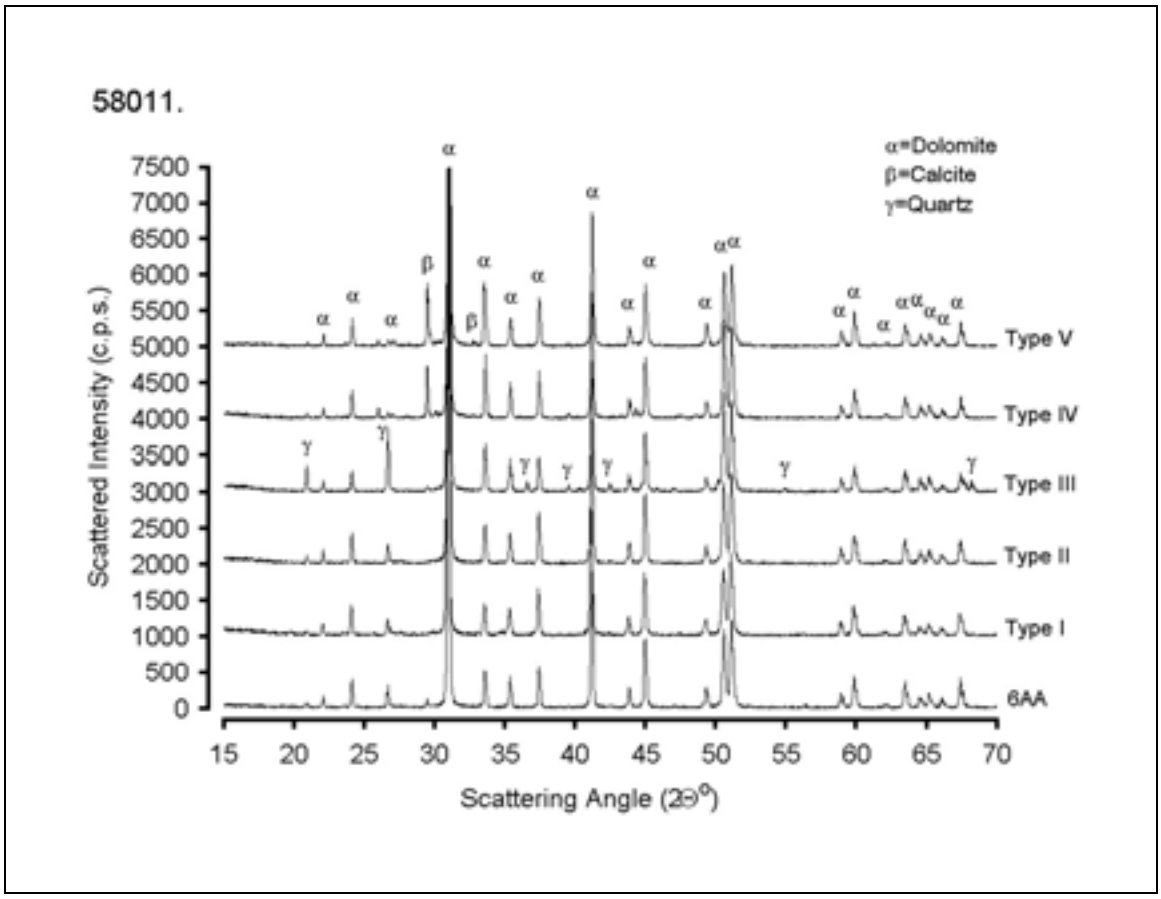


Figure 6-5: X-ray diffraction pattern from aggregate source.

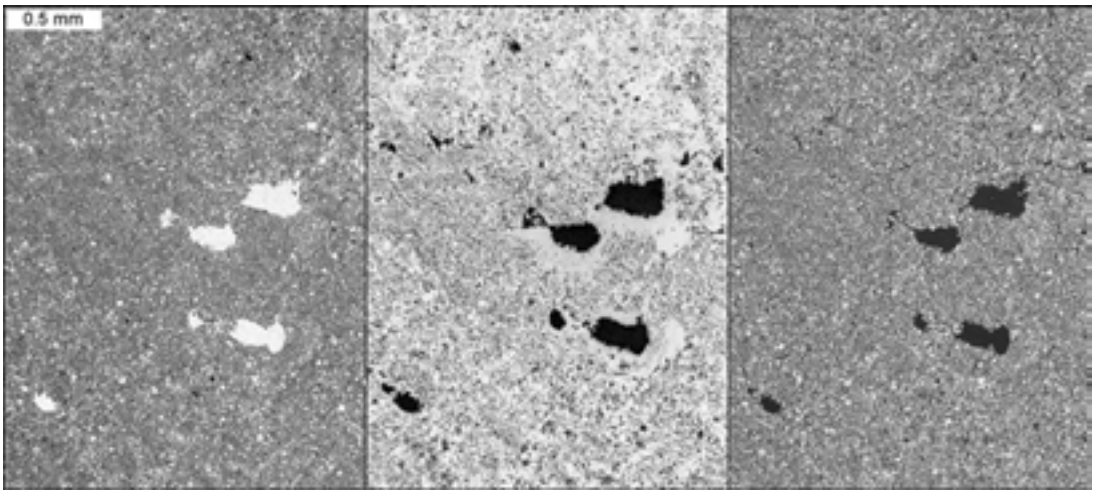


Figure 6-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

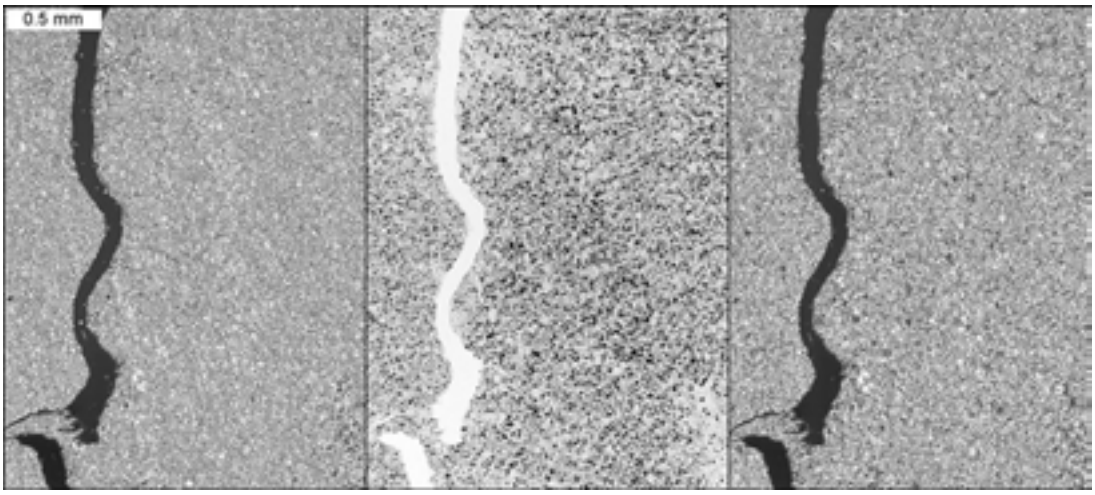


Figure 6-6b: Thin section micrographs for Type II, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

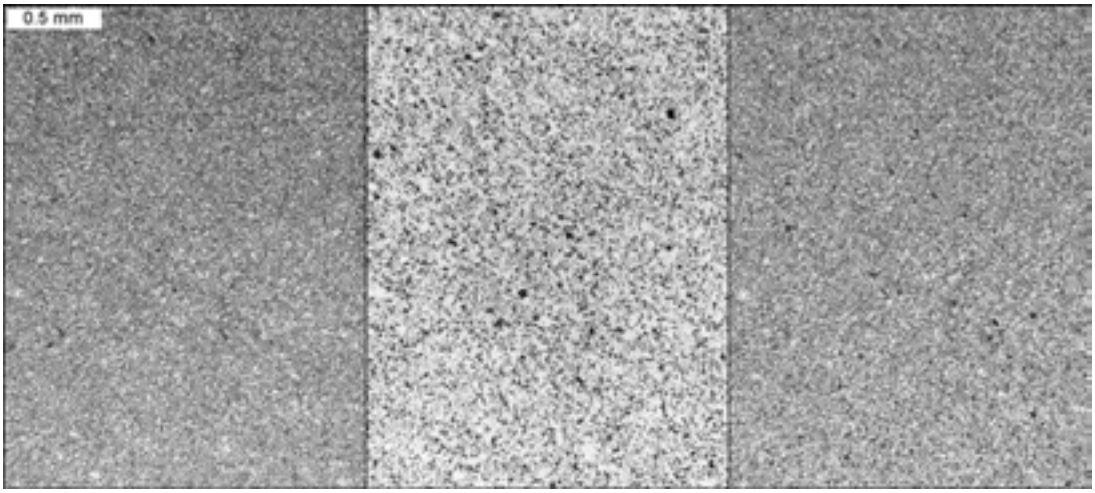


Figure 6-6c: Thin section micrographs for Type III, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

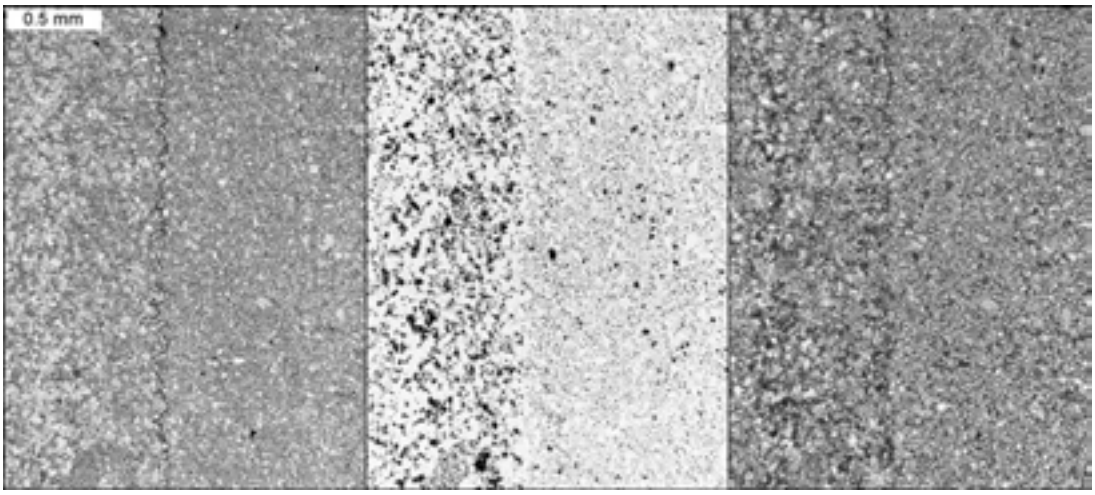


Figure 6-6d: Thin section micrographs for Type IV, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

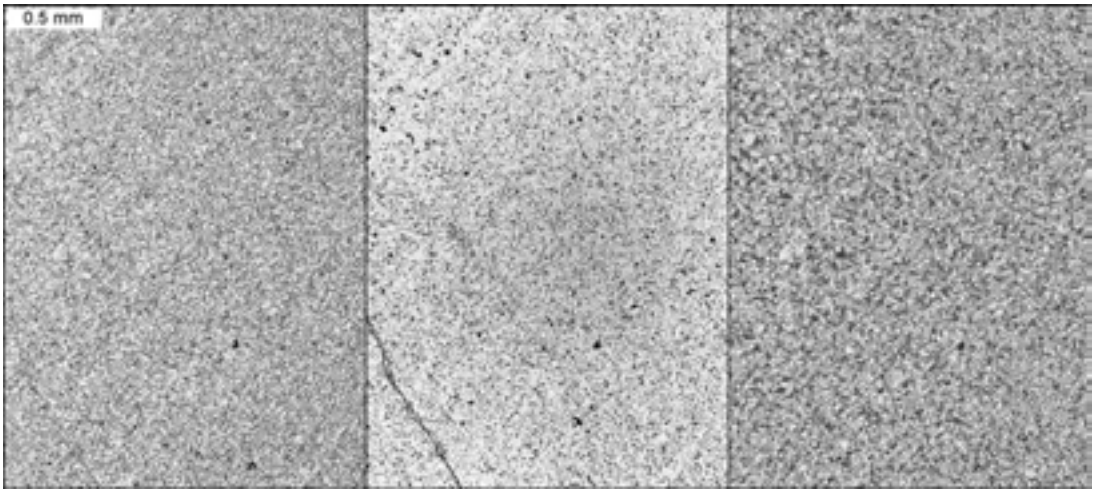


Figure 6-6e: Thin section micrographs for Type V, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

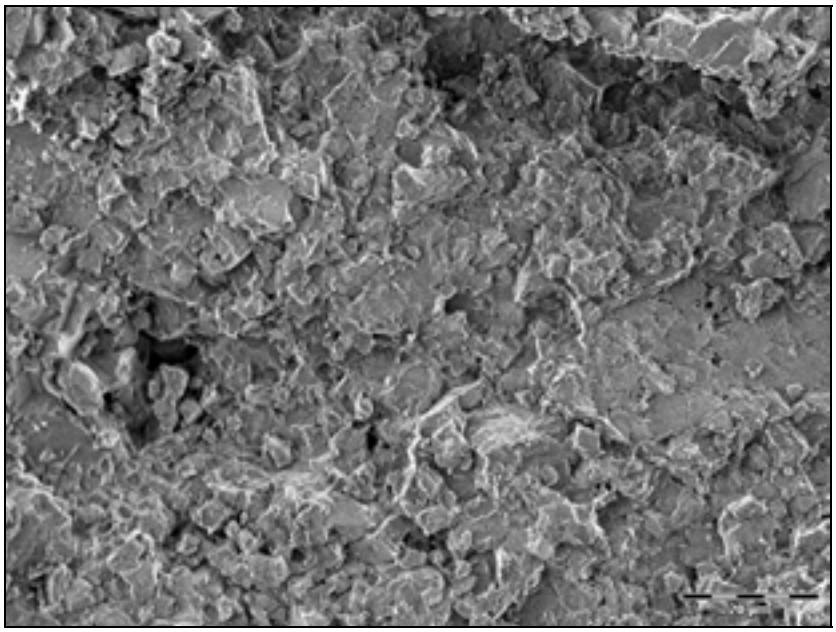


Figure 6-7a: ESEM photo of fracture surface for type I.

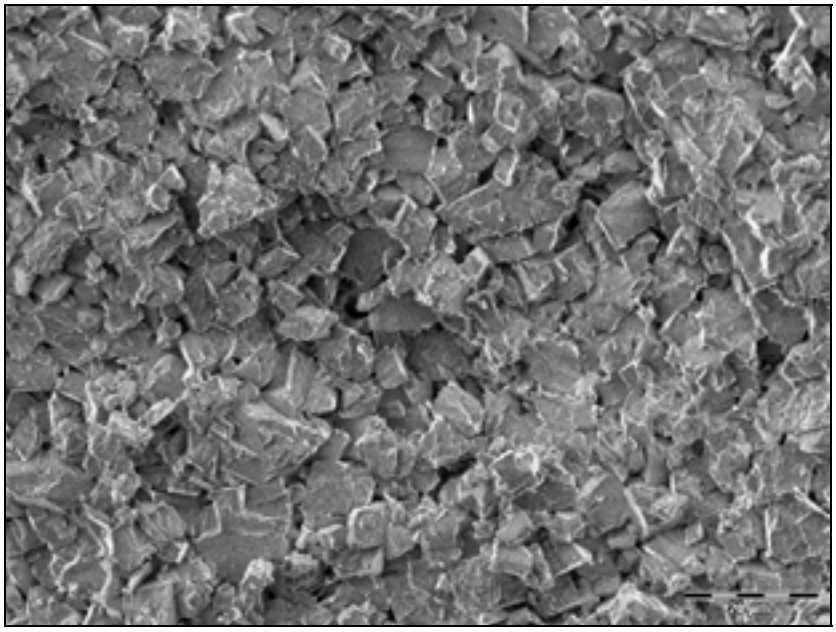


Figure 6-7b: ESEM photo of fracture surface for type II.

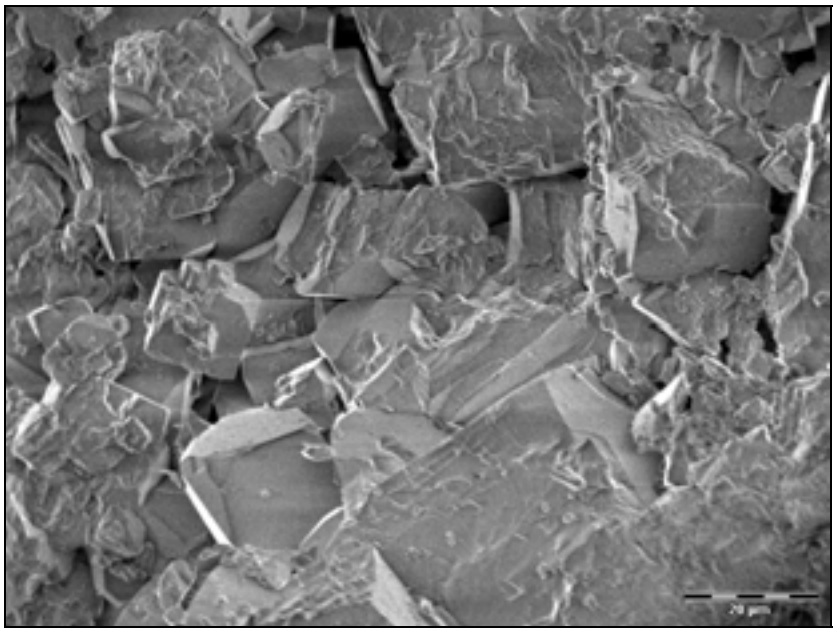


Figure 6-7c: ESEM photo of fracture surface for type III.

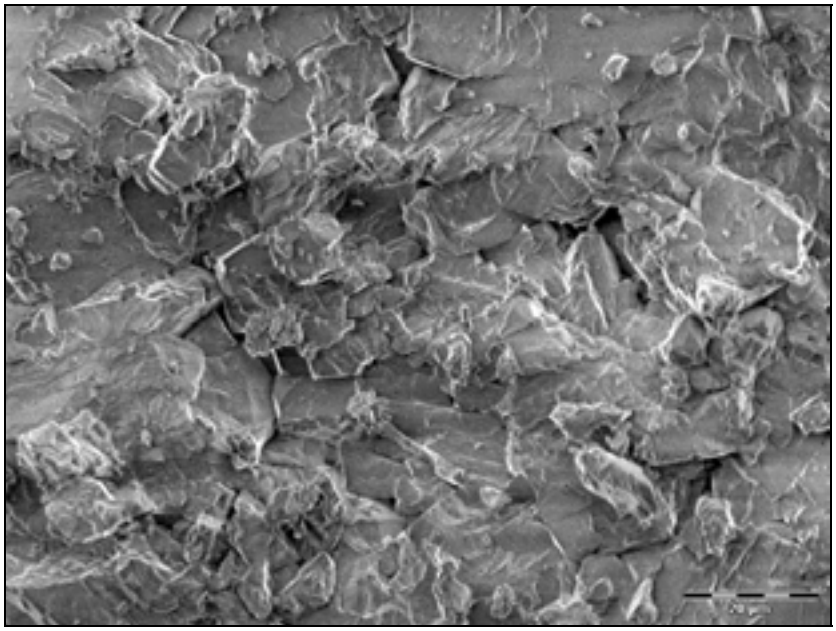


Figure 6-7d: ESEM photo of fracture surface for type IV.

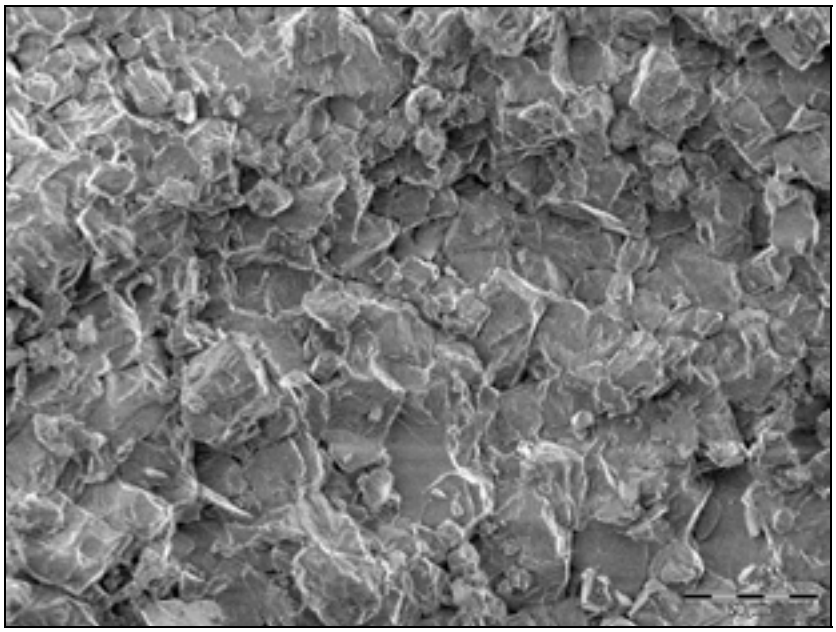


Figure 6-7e: ESEM photo of fracture surface for type V.

Table 6-9: Grain intercept length statistics, by type:

Grain intercept length (μm)	I	II	III	IV	V
Average	50.5	38.1	42.3	36.6	45.8
Median	44.4	32.7	36.6	32.7	36.6
Standard deviation	30.6	22.3	25.0	22.5	28.0
Maximum	250.6	161.1	180.6	141.7	219.5
Minimum	5.5	9.4	5.5	9.4	9.4

Table 6-10: Micro-pore diameter statistics, by type:

Micro-pore diameter (μm)	I	II	III	IV	V
Average	2.41	2.73	1.93	1.71	1.90
Median	1.24	1.36	0.99	1.03	1.16
Standard deviation	3.78	4.01	3.59	2.25	2.33
Maximum	68.52	61.15	62.63	49.39	42.79
Minimum	0.60	0.60	0.60	0.60	0.60

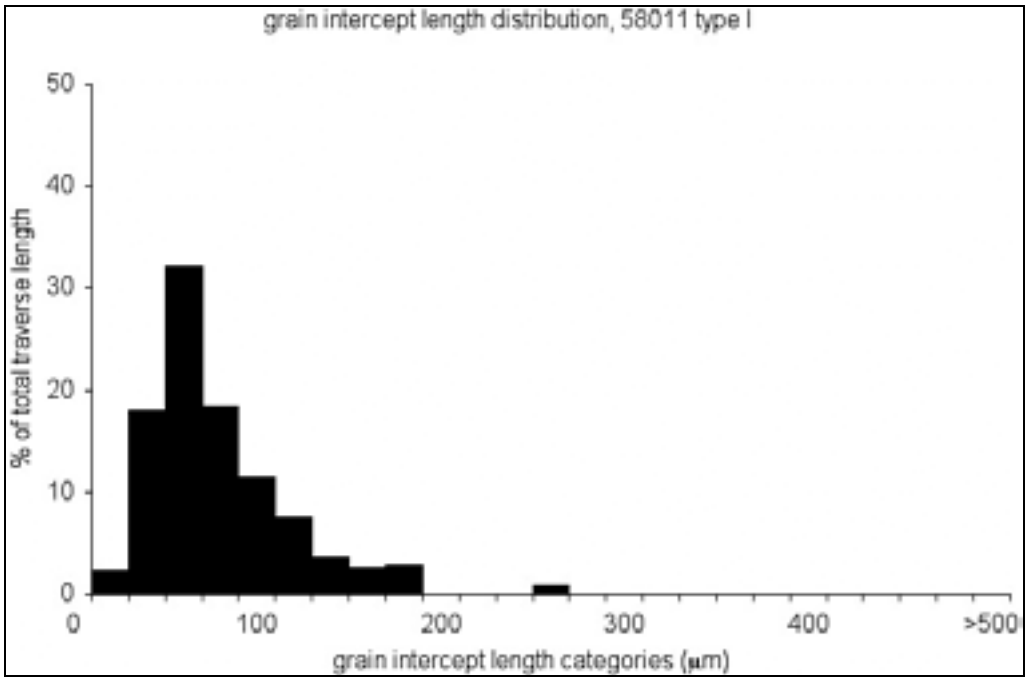


Figure 6-8a: Grain intercept length distribution from petrographic microscope traverse, Type I.

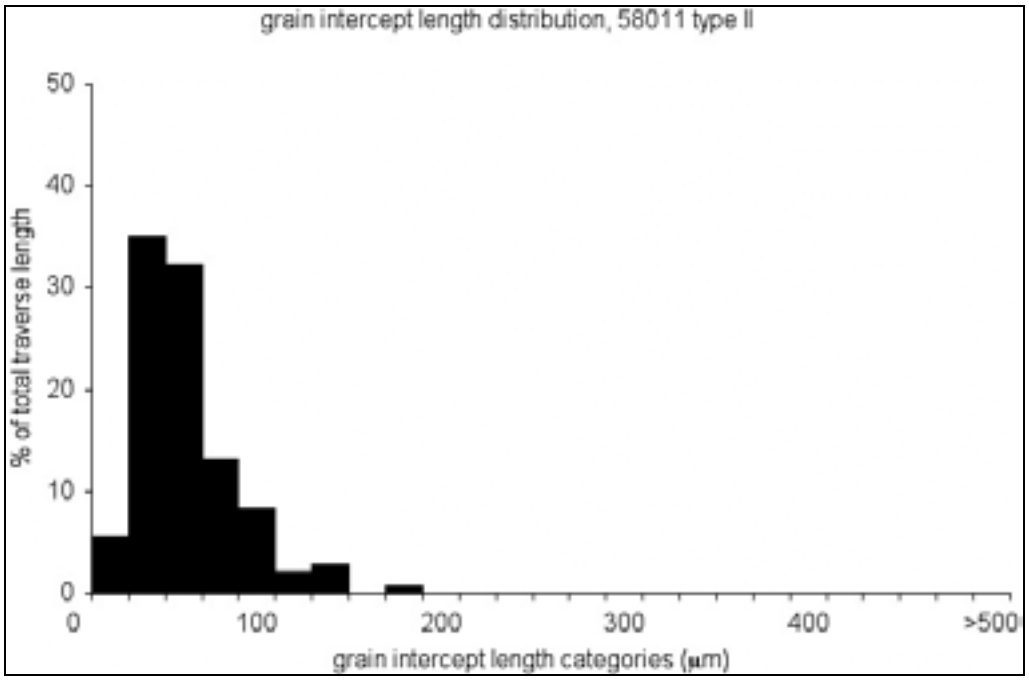


Figure 6-8b: Grain intercept length distribution from petrographic microscope traverse, Type II.

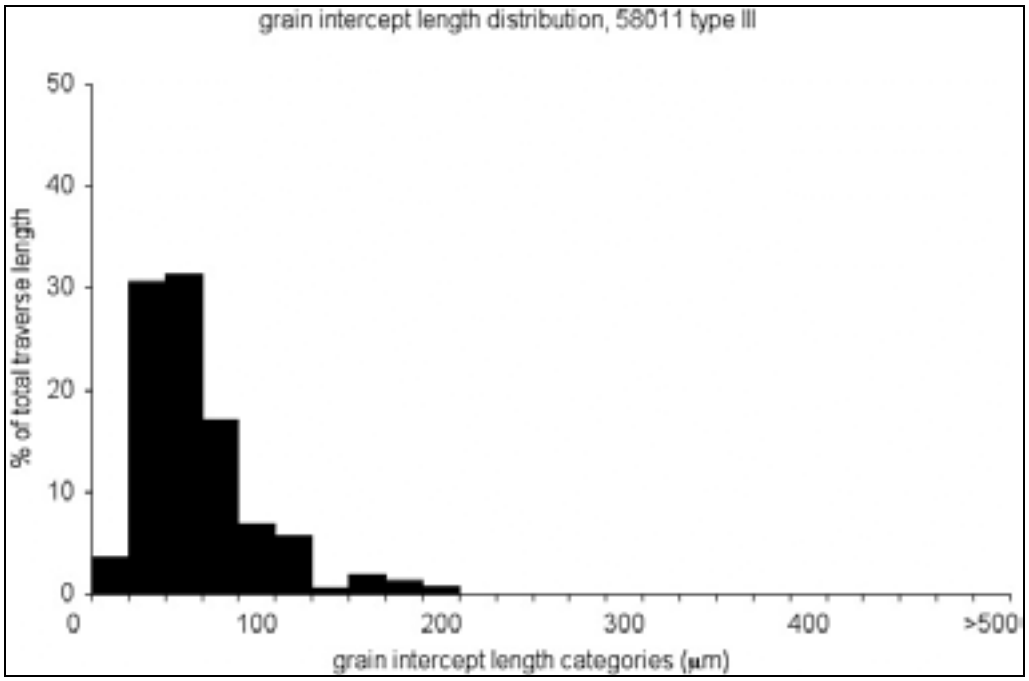


Figure 6-8c: Grain intercept length distribution from petrographic microscope traverse, Type III.

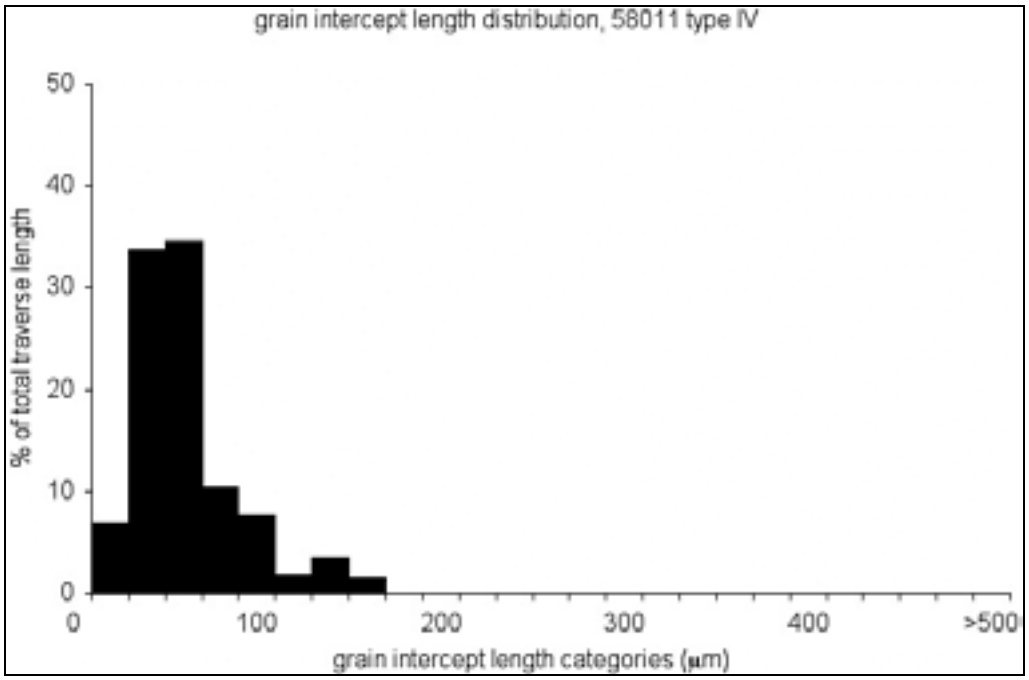


Figure 6-8d: Grain intercept length distribution from petrographic microscope traverse, Type IV.

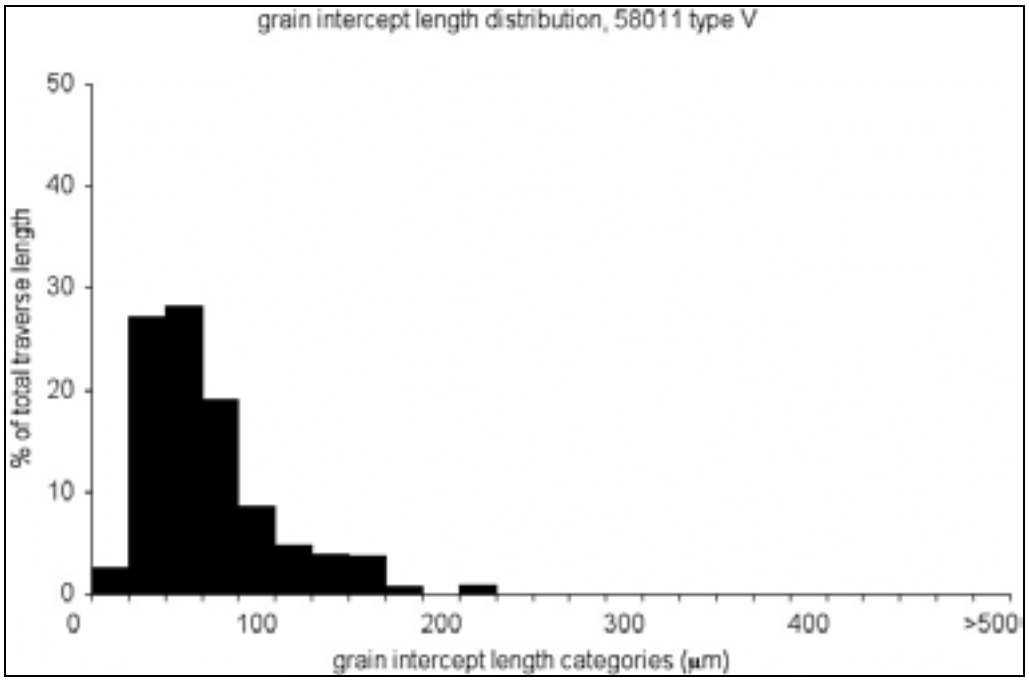


Figure 6-8e: Grain intercept length distribution from petrographic microscope traverse, Type V.

Table 6-11a: Data for grain intercept length distribution plot shown in Figure 6-8a, (type I):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	2.32	2.32
20 to <40	17.98	20.30
40 to <60	32.13	52.42
60 to <80	18.46	70.89
80 to <100	11.51	82.39
100 to <120	7.49	89.88
120 to <140	3.65	93.53
140 to <160	2.64	96.17
160 to <180	2.93	99.10
180 to <200	0.00	99.10
200 to <220	0.00	99.10
220 to <240	0.00	99.10
240 to <280	0.90	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 6-11b: Data for grain intercept length distribution plot shown in Figure 6-8b, (type II):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	5.59	5.59
20 to <40	34.97	40.56
40 to <60	32.39	72.95
60 to <80	13.10	86.05
80 to <100	8.25	94.30
100 to <120	2.06	96.36
120 to <140	2.91	99.27
140 to <160	0.00	99.27
160 to <180	0.73	100.00
180 to <200	0.00	100.00
200 to <220	0.00	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 6-11c: Data for grain intercept length distribution plot shown in Figure 6-8c, (type III):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	3.58	3.58
20 to <40	30.70	34.29
40 to <60	31.38	65.67
60 to <80	17.06	82.73
80 to <100	6.90	89.64
100 to <120	5.70	95.34
120 to <140	0.58	95.92
140 to <160	1.92	97.83
160 to <180	1.39	99.22
180 to <200	0.78	100.00
200 to <220	0.00	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 6-11d: Data for grain intercept length distribution plot shown in Figure 6-8d, (type IV):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	6.92	6.92
20 to <40	33.74	40.66
40 to <60	34.55	75.21
60 to <80	10.44	85.66
80 to <100	7.68	93.34
100 to <120	1.76	95.10
120 to <140	3.40	98.50
140 to <160	1.50	100.00
160 to <180	0.00	100.00
180 to <200	0.00	100.00
200 to <220	0.00	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 6-11e: Data for grain intercept length distribution plot shown in Figure 6-8e, (type V):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	2.63	2.63
20 to <40	27.21	29.84
40 to <60	28.29	58.13
60 to <80	19.02	77.15
80 to <100	8.59	85.74
100 to <120	4.88	90.63
120 to <140	3.88	94.50
140 to <160	3.83	98.34
160 to <180	0.70	99.04
180 to <200	0.00	99.04
200 to <220	0.96	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

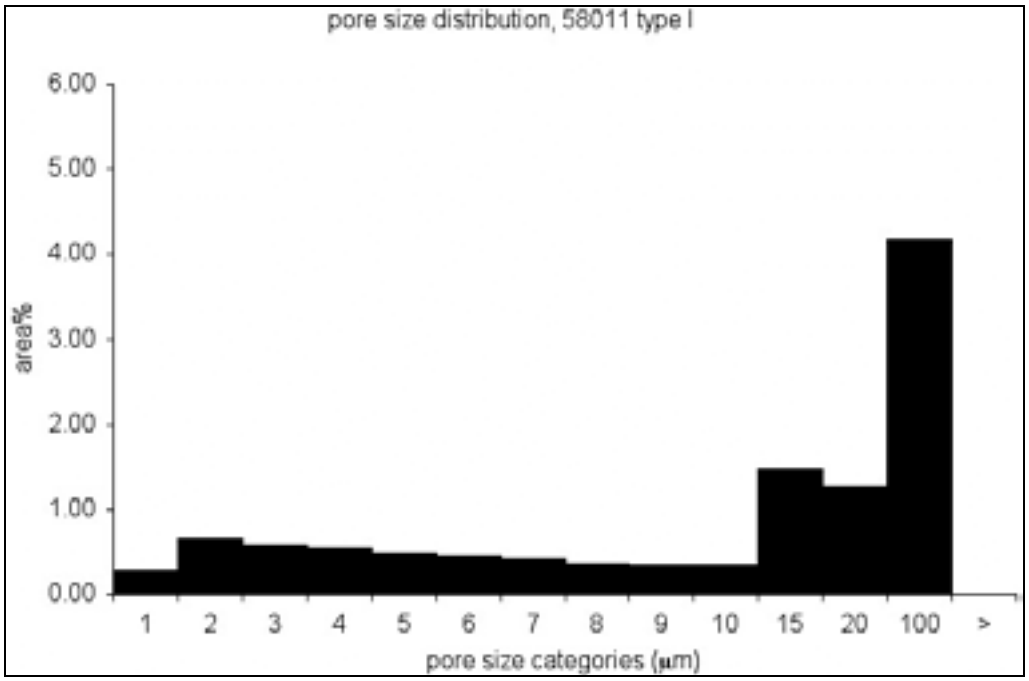


Figure 6-9a: Micro-pore size distribution from back-scattered electron images, type I.

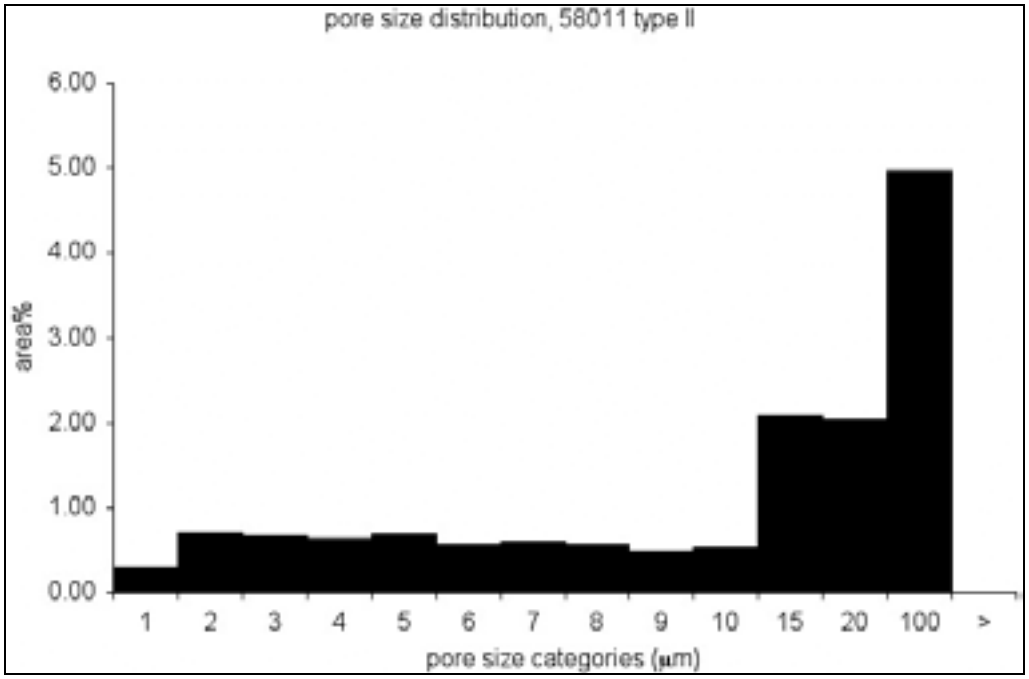


Figure 6-9b: Micro-pore size distribution from back-scattered electron images, type II.

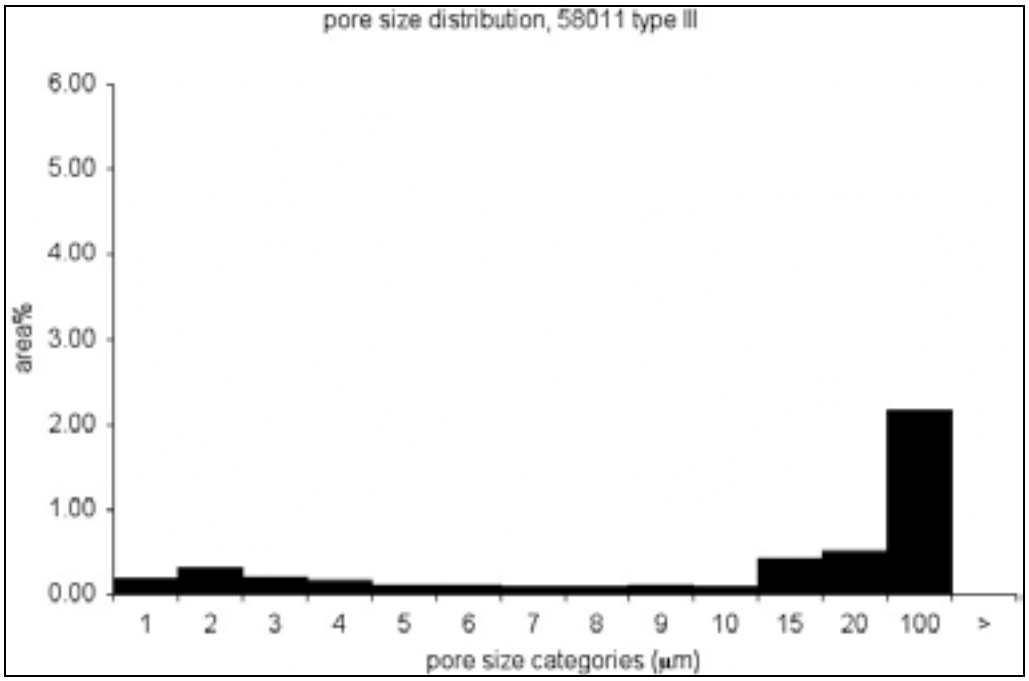


Figure 6-9c: Micro-pore size distribution from back-scattered electron images, type III.

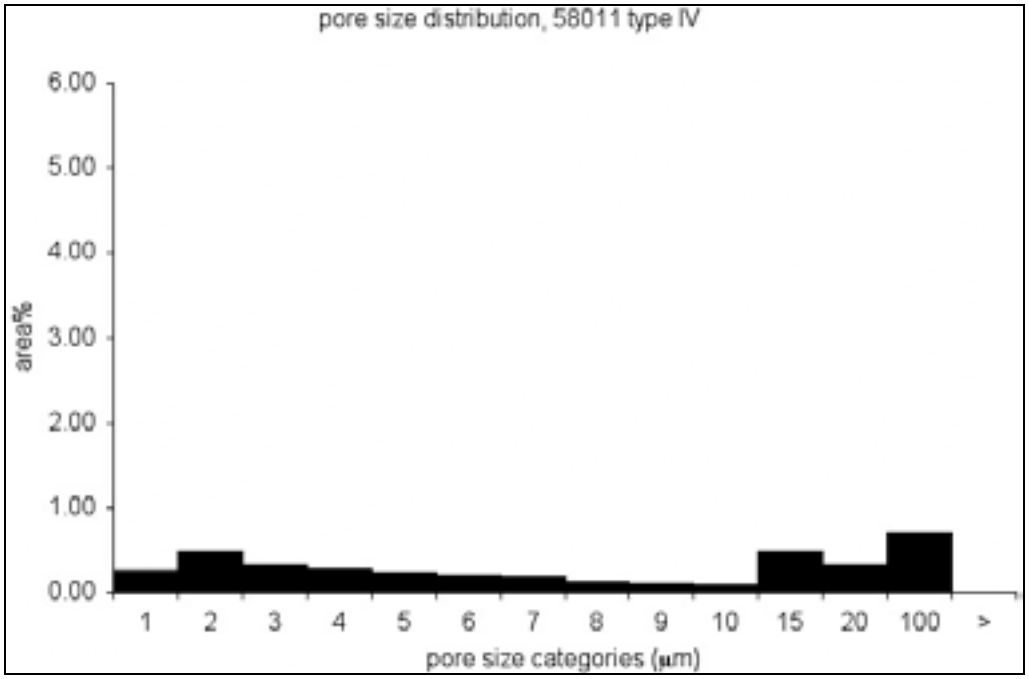


Figure 6-9d: Micro-pore size distribution from back-scattered electron images, type IV.

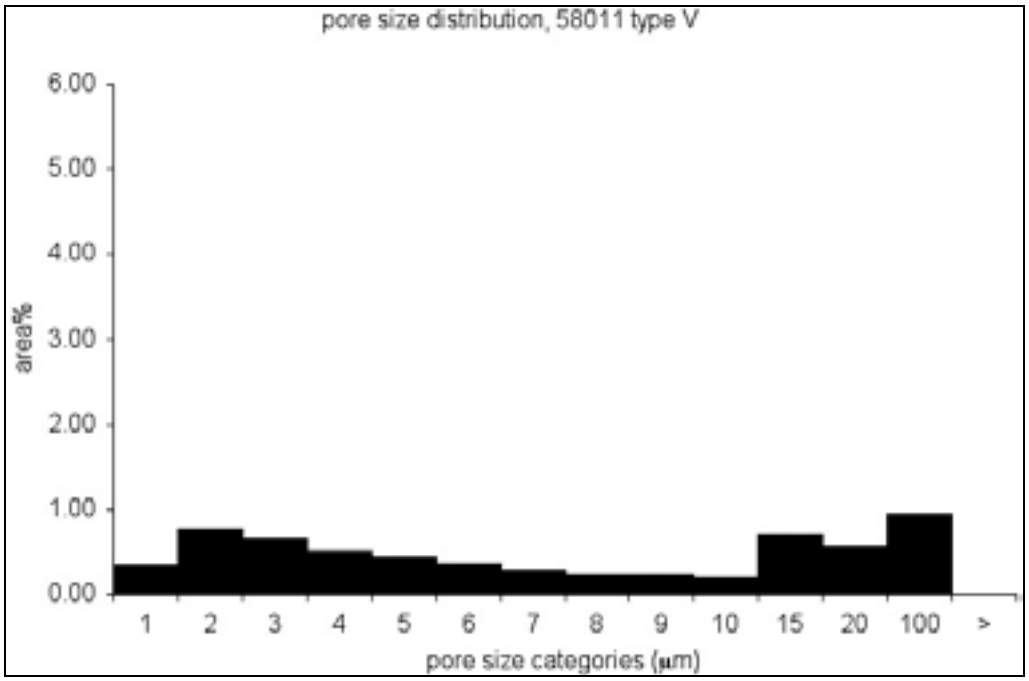


Figure 6-9e: Micro-pore size distribution from back-scattered electron images, type V.

Table 6-12a: Data for micro-pore size distribution plot shown in Figure 6-9a, (type I).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.28	2.47
1 to <2	0.66	8.23
2 to <3	0.58	13.37
3 to <4	0.54	18.07
4 to <5	0.48	22.30
5 to <6	0.44	26.20
6 to <7	0.42	29.91
7 to <8	0.37	33.14
8 to <9	0.34	36.11
9 to <10	0.35	39.18
10 to <15	1.47	52.12
15 to <20	1.28	63.34
20 to <100	4.17	100.00
100 and >	0.00	100.00
sum	11.38	

Table 6-12b: Data for micro-pore size distribution plot shown in Figure 6-9b, (type II).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.29	1.94
1 to <2	0.71	6.71
2 to <3	0.67	11.25
3 to <4	0.63	15.50
4 to <5	0.68	20.11
5 to <6	0.57	23.94
6 to <7	0.60	27.99
7 to <8	0.56	31.77
8 to <9	0.50	35.12
9 to <10	0.53	38.69
10 to <15	2.09	52.76
15 to <20	2.04	66.49
20 to <100	4.97	100.00
100 and >	0.00	100.00
sum	14.83	

Table 6-12c: Data for micro-pore size distribution plot shown in Figure 6-9c, (type III).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.18	4.06
1 to <2	0.31	10.89
2 to <3	0.19	15.11
3 to <4	0.16	18.53
4 to <5	0.12	21.08
5 to <6	0.11	23.40
6 to <7	0.10	25.54
7 to <8	0.09	27.46
8 to <9	0.11	29.85
9 to <10	0.09	31.88
10 to <15	0.42	41.14
15 to <20	0.51	52.40
20 to <100	2.16	100.00
100 and >	0.00	100.00
sum	4.54	

Table 6-12d: Data for micro-pore size distribution plot shown in Figure 6-9d, (type IV).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.26	6.79
1 to <2	0.49	19.63
2 to <3	0.33	28.27
3 to <4	0.27	35.19
4 to <5	0.23	41.14
5 to <6	0.21	46.46
6 to <7	0.18	51.21
7 to <8	0.13	54.68
8 to <9	0.11	57.62
9 to <10	0.10	60.10
10 to <15	0.50	72.98
15 to <20	0.33	81.46
20 to <100	0.71	100.00
100 and >	0.00	100.00
sum	3.85	

Table 6-12e: Data for micro-pore size distribution plot shown in Figure 6-9e, (type V).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.34	5.38
1 to <2	0.77	17.69
2 to <3	0.65	28.09
3 to <4	0.51	36.32
4 to <5	0.44	43.37
5 to <6	0.36	49.21
6 to <7	0.27	53.50
7 to <8	0.24	57.34
8 to <9	0.24	61.17
9 to <10	0.21	64.47
10 to <15	0.71	75.90
15 to <20	0.56	84.91
20 to <100	0.94	100.00
100 and >	0.00	100.00
sum	6.24	

Table 6-13: Coefficient of thermal expansion, by type:

Type	Coefficient of thermal expansion (mm/mm/degree C):
I	7.68E-06
II	7.68E-06
III	7.68E-06
IV	7.68E-06
V	7.68E-06

71003 - Rogers City

Table 7-1: Pit name, location, and general geologic information:

Pit Number	71003
Name	Rogers City
Longitude	-83.79
Latitude	45.41
Era	Palaeozoic
Period	Devonian
Group	Traverse
Member	
Rock Type	limestone
Description	Tan to brown, to dark brown with abundant fossils in a fine grained limestone matrix.

Table 7-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	4.549E-06
Bulk specific gravity (oven dry)	2.52
Bulk specific gravity (saturated surface dry)	2.56
Apparent specific gravity	2.64
Absorption %	1.81
Average grain intercept length (µm)	30.9
Area % micro-pores	12.15
Average micro-pore diameter (µm)	1.76

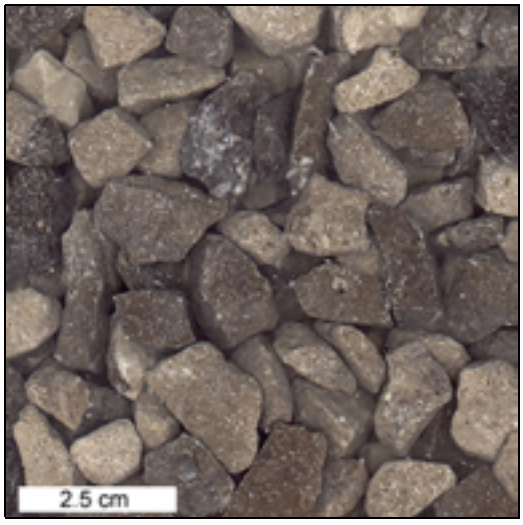


Figure 7-1: Photo of 3/8" sieve fraction of 6AA product.

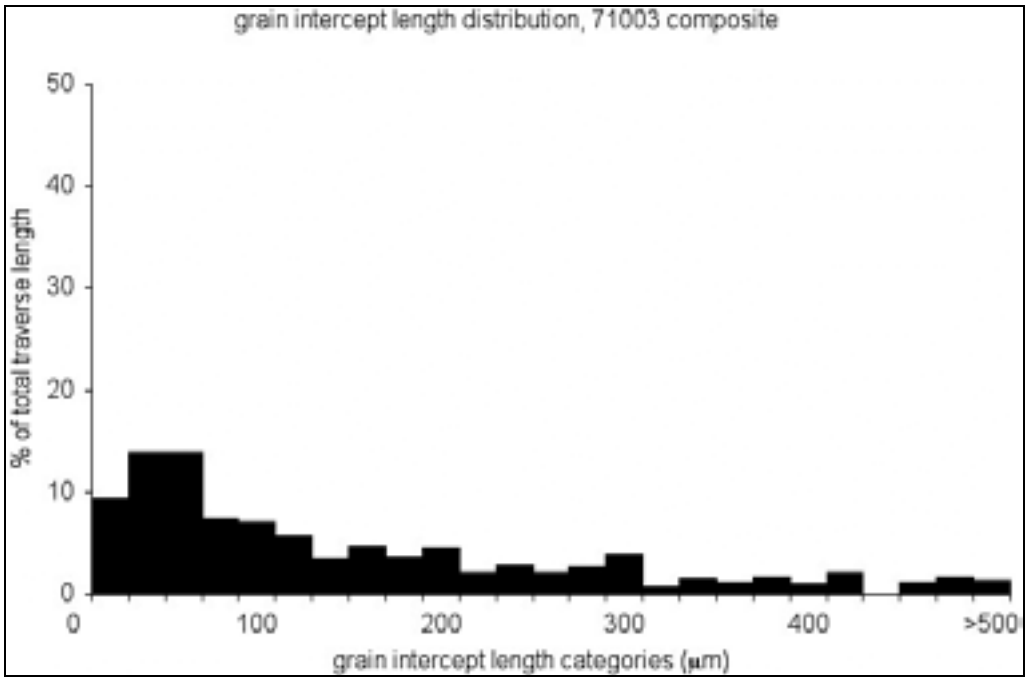


Figure 7-2: Grain intercept length distribution from petrographic microscope traverse.

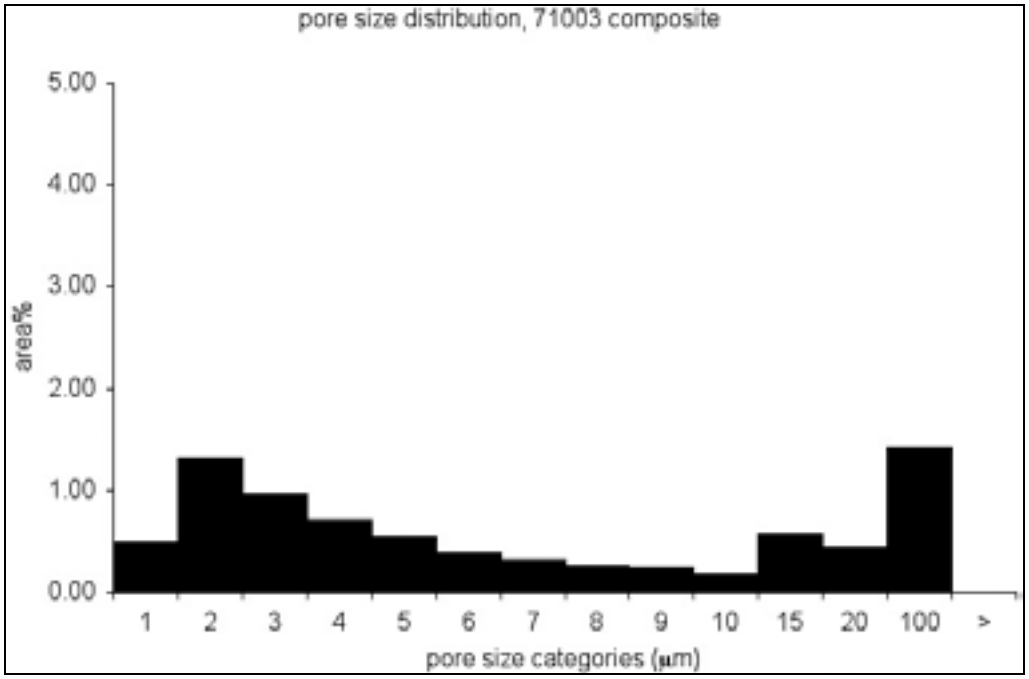


Figure 7-3: Micro-pore size distribution from back-scattered electron images.

Table 7-3: Data for grain intercept length distribution plot shown in Figure 7-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	9.38	9.38
20 to <40	13.95	23.33
40 to <60	13.95	37.28
60 to <80	7.39	44.67
80 to <100	7.07	51.74
100 to <120	5.68	57.42
120 to <140	3.50	60.92
140 to <160	4.67	65.60
160 to <180	3.69	69.29
180 to <200	4.52	73.81
200 to <220	2.17	75.98
220 to <240	2.92	78.90
240 to <280	2.04	80.94
280 to <300	2.79	83.73
300 to <320	3.87	87.60
320 to <340	0.82	88.41
340 to <360	1.44	89.86
360 to <380	1.23	91.08
380 to <400	1.60	92.68
400 to <420	1.02	93.70
420 to <440	2.17	95.87
440 to <460	0.00	95.87
460 to <480	1.18	97.05
480 to <500	1.65	98.70
500 and >	1.30	100.00

Table 7-4: Data for micro-pore size distribution plot shown in Figure 7-3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.50	6.35
1 to <2	1.32	23.14
2 to <3	0.97	35.51
3 to <4	0.71	44.63
4 to <5	0.54	51.50
5 to <6	0.39	56.44
6 to <7	0.32	60.58
7 to <8	0.26	63.85
8 to <9	0.24	66.87
9 to <10	0.17	69.09
10 to <15	0.57	76.39
15 to <20	0.44	81.95
20 to <100	1.41	100.00
100 and >	0.00	100.00
sum	7.83	

Table 7-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	0.57
Al_2O_3	0.04
SiO_2	0.29
S	0.07
CaO	55.12
Fe_2O_3	0.11
sum	56.20

Table 7-6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	2.59
Calcite - $CaCO_3$	96.97
Pyrite - FeS_2	0.12
Other	0.29
sum	99.98

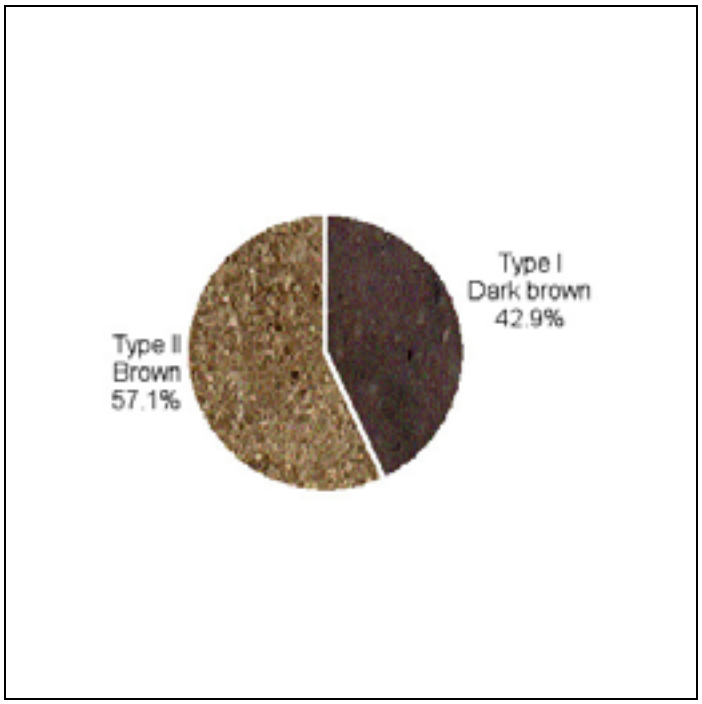


Figure 7-4: Rock types within aggregate source based on differences in color and texture.

Table 7-7: Composition as determined by x-ray fluorescence, by type:

Oxide/element wt%	I	II
MgO	0.86	0.57
Al_2O_3	0.06	0.01
SiO_2	0.30	0.10
S	0.09	0.06
CaO	54.77	55.35
Fe_2O_3	0.12	0.10
sum	56.20	56.20

Table 7-8: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral wt%	I	II
Dolomite - $Ca,Mg(CO_3)_2$	3.93	2.62
Calcite - $CaCO_3$	95.62	97.36
Pyrite - FeS_2	0.16	0.11
Other	0.30	0.10
sum	100.02	100.20

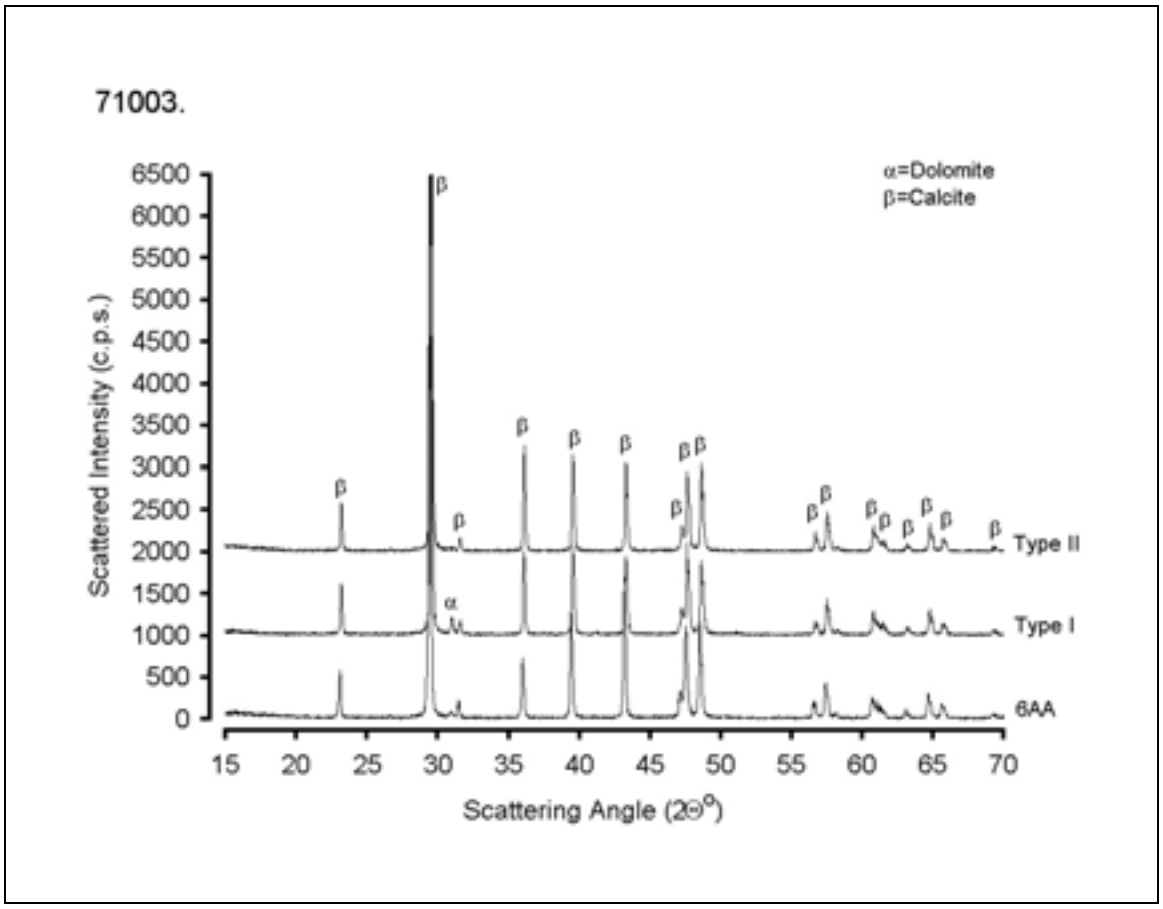


Figure 7-5: X-ray diffraction pattern from aggregate source.

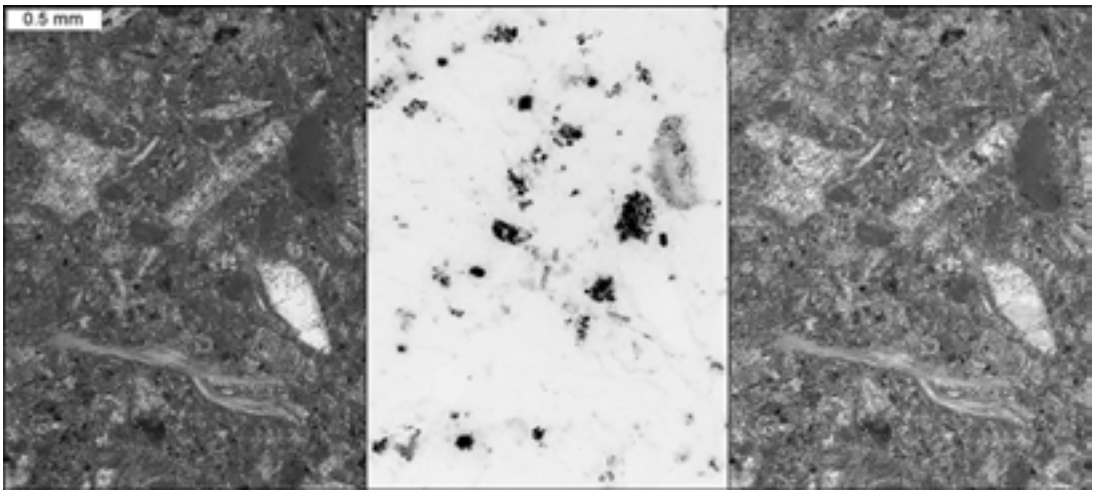


Figure 7-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

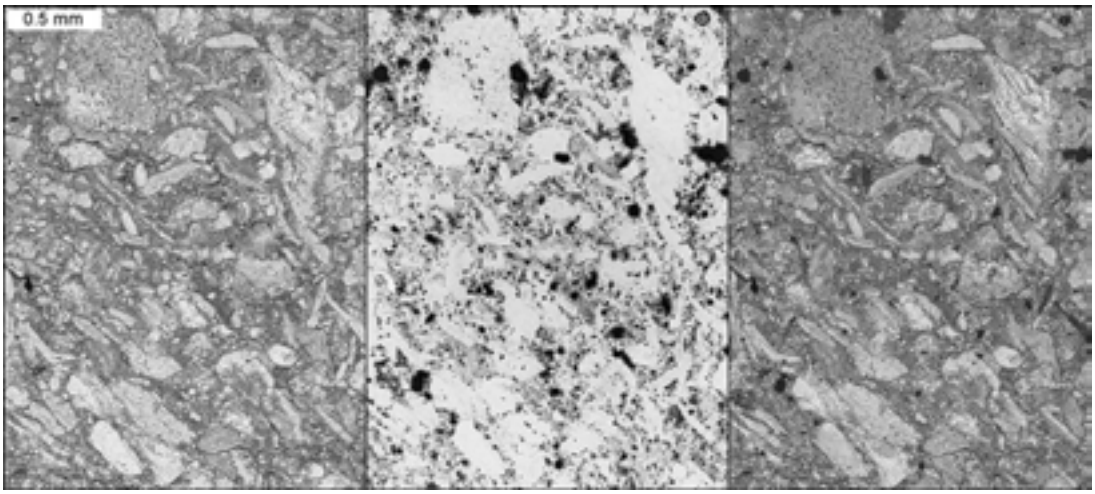


Figure 7-6b: Thin section micrographs for Type II, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

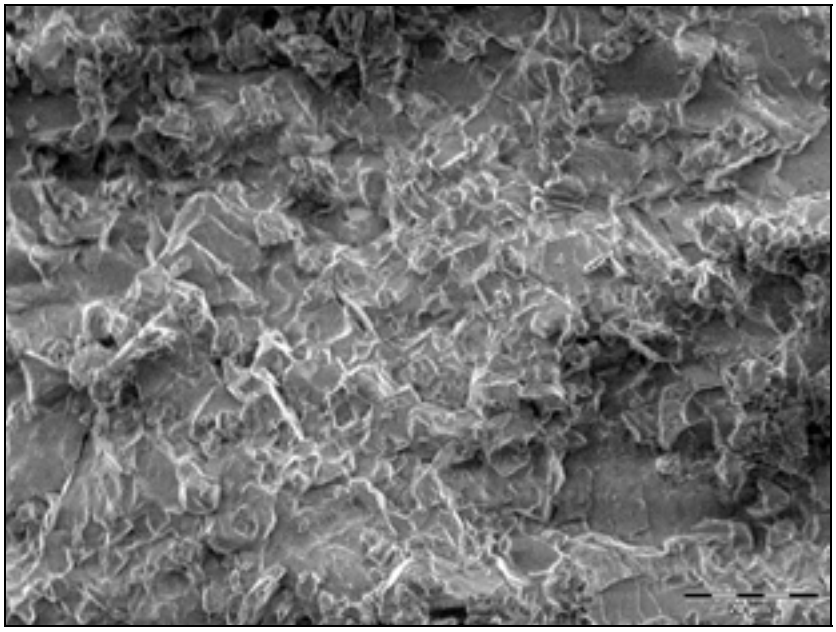


Figure 7-7a: ESEM photo of fracture surface for type I.

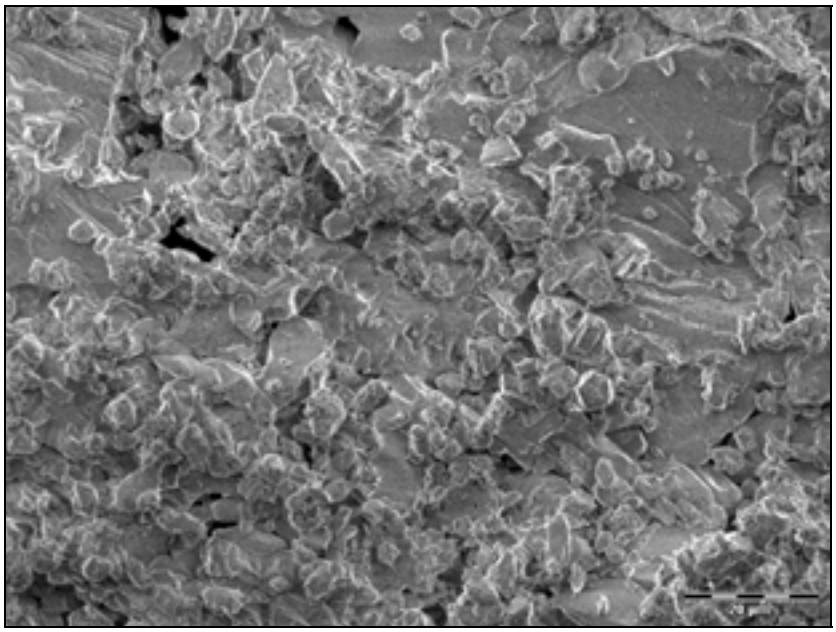


Figure 7-7b: ESEM photo of fracture surface for type II.

Table 7-9: Grain intercept length statistics, by type:

Grain intercept length (μm)	I	II
Average	30.9	146.7
Median	20.4	87.2
Standard deviation	31.8	161.3
Maximum	285.7	962.7
Minimum	4.7	5.5

Table 7-10: Micro-pore diameter statistics, by type:

Micro-pore diameter (μm)	I	II
Average	1.67	1.82
Median	1.22	1.16
Standard deviation	1.52	2.30
Maximum	42.70	71.96
Minimum	0.60	0.60

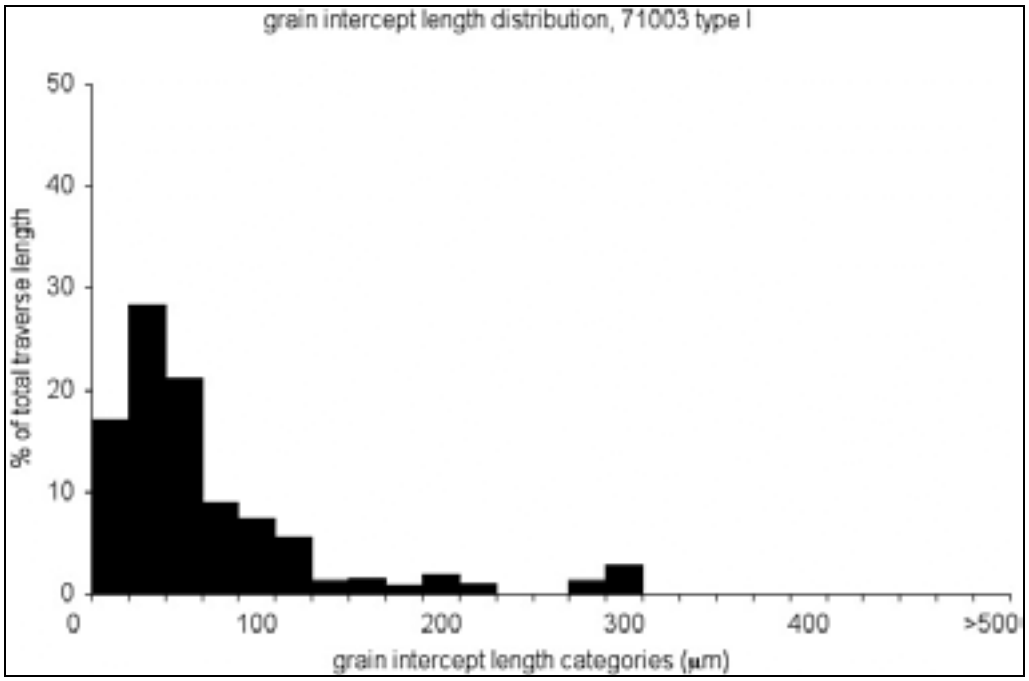


Figure 7-8a: Grain intercept length distribution from petrographic microscope traverse, Type I.

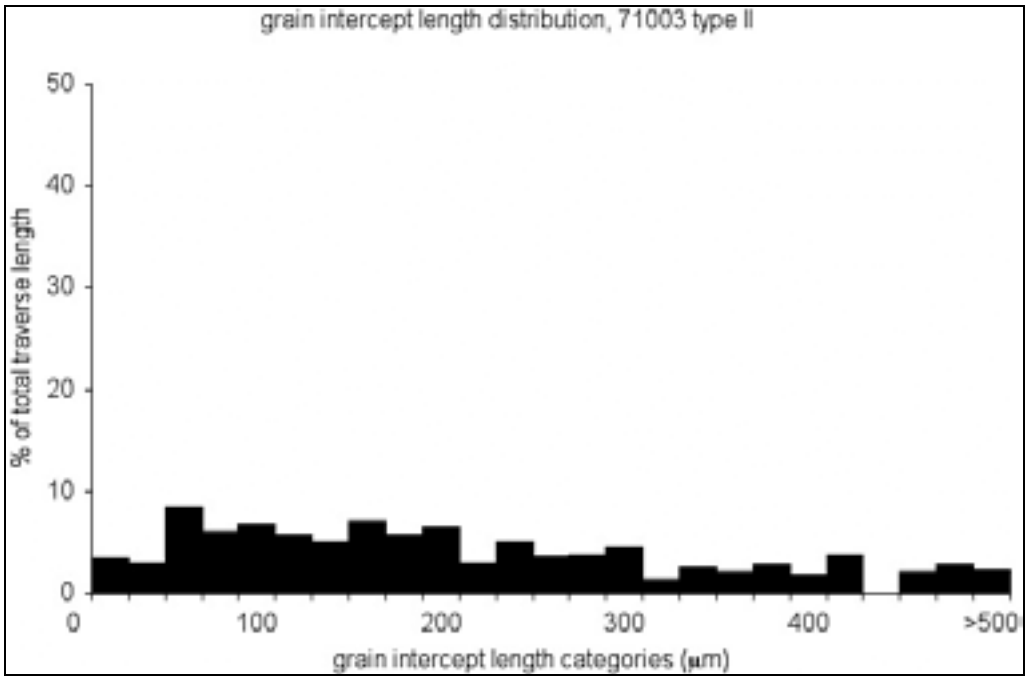


Figure 7-8b: Grain intercept length distribution from petrographic microscope traverse, Type II.

Table 7-11a: Data for grain intercept length distribution plot shown in Figure 7-8a, (type I):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	17.14	17.14
20 to <40	28.42	45.56
40 to <60	21.19	66.75
60 to <80	9.09	75.85
80 to <100	7.40	83.25
100 to <120	5.61	88.86
120 to <140	1.34	90.20
140 to <160	1.52	91.72
160 to <180	0.91	92.63
180 to <200	1.92	94.55
200 to <220	1.11	95.66
220 to <240	0.00	95.66
240 to <280	0.00	95.66
280 to <300	1.41	97.07
300 to <320	2.93	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 7-11b: Data for grain intercept length distribution plot shown in Figure 7-8b, (type II):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	3.54	3.54
20 to <40	3.06	6.61
40 to <60	8.51	15.12
60 to <80	6.11	21.23
80 to <100	6.82	28.05
100 to <120	5.74	33.79
120 to <140	5.12	38.91
140 to <160	7.04	45.95
160 to <180	5.79	51.74
180 to <200	6.47	58.21
200 to <220	2.97	61.19
220 to <240	5.11	66.29
240 to <280	3.58	69.87
280 to <300	3.82	73.69
300 to <320	4.58	78.27
320 to <340	1.43	79.70
340 to <360	2.52	82.23
360 to <380	2.15	84.37
380 to <400	2.80	87.18
400 to <420	1.78	88.96
420 to <440	3.81	92.76
440 to <460	0.00	92.76
460 to <480	2.07	94.83
480 to <500	2.90	97.73
500 and >	2.27	100.00

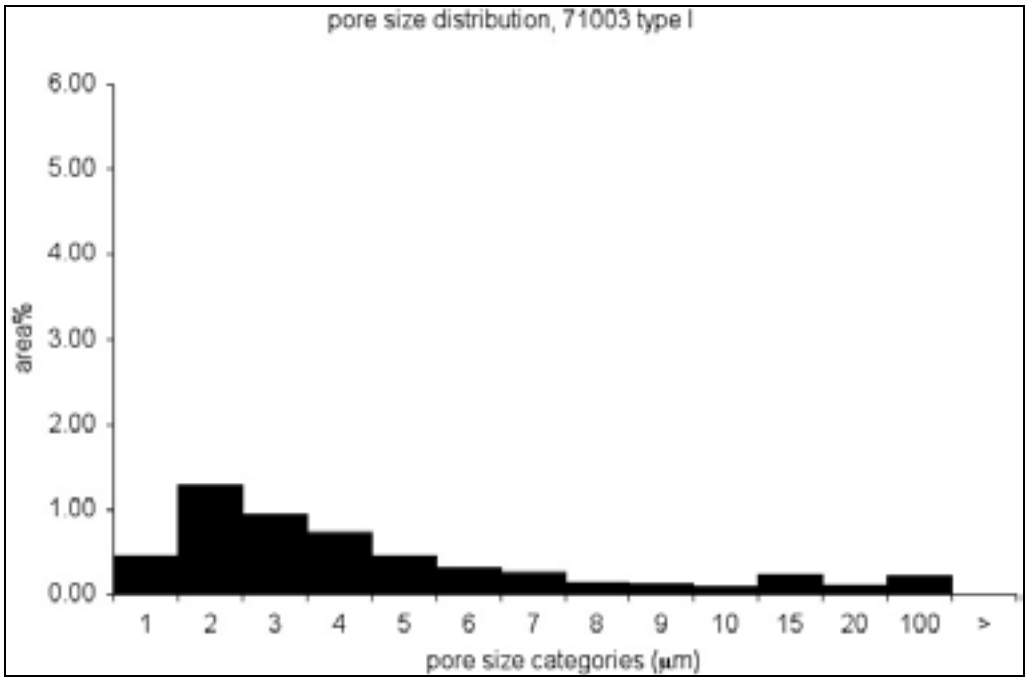


Figure 7-9a: Micro-pore size distribution from back-scattered electron images, type I.

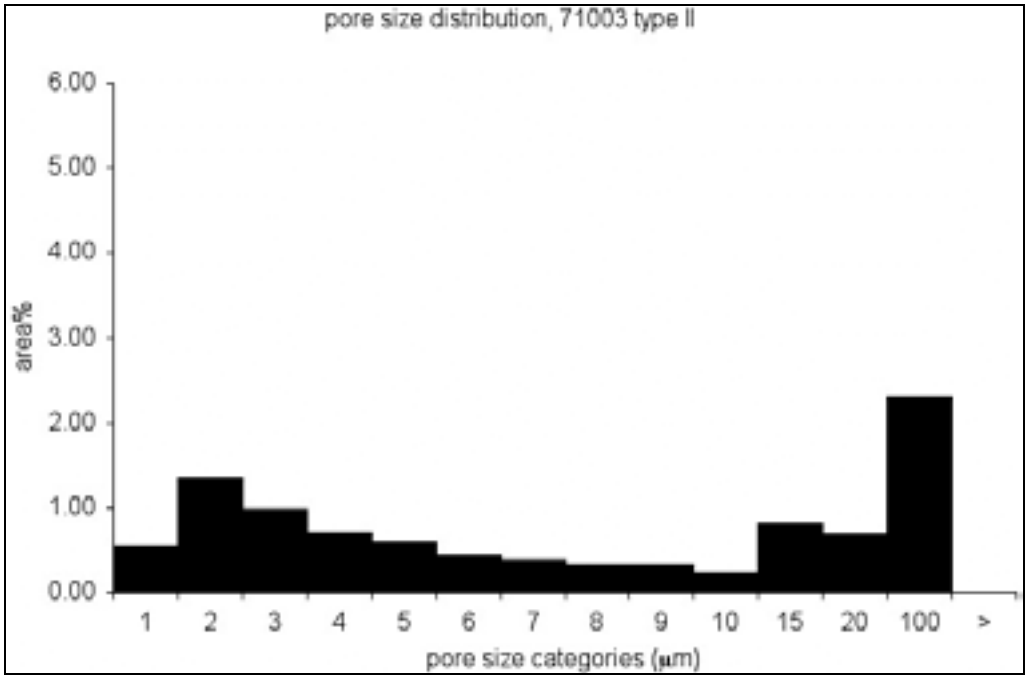


Figure 7-9b: Micro-pore size distribution from back-scattered electron images, type II.

Table 7-12a: Data for micro-pore size distribution plot shown in Figure 7-9a, (type I).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.45	8.33
1 to <2	1.29	32.26
2 to <3	0.95	49.93
3 to <4	0.73	63.43
4 to <5	0.45	71.85
5 to <6	0.32	77.72
6 to <7	0.25	82.37
7 to <8	0.15	85.20
8 to <9	0.12	87.47
9 to <10	0.09	89.21
10 to <15	0.24	93.74
15 to <20	0.11	95.81
20 to <100	0.23	100.00
100 and >	0.00	100.00
sum	5.37	

Table 7-12b: Data for micro-pore size distribution plot shown in Figure 7-9b, (type II).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.53	5.52
1 to <2	1.34	19.33
2 to <3	0.98	29.49
3 to <4	0.71	36.79
4 to <5	0.60	43.02
5 to <6	0.44	47.57
6 to <7	0.38	51.49
7 to <8	0.34	54.95
8 to <9	0.32	58.28
9 to <10	0.23	60.70
10 to <15	0.82	69.15
15 to <20	0.68	76.17
20 to <100	2.31	100.00
100 and >	0.00	100.00
sum	9.69	

Table 7-13: Coefficient of thermal expansion, by type:

Type	Coefficient of thermal expansion (mm/mm/degree C):
I	3.73E-06
II	5.37E-06

71047 - Presque Isle

Table 8-1: Pit name, location, and general geologic information:

Pit Number	71047
Name	Presque Isle
Longitude	-83.43
Latitude	45.29
Era	Palaeozoic
Period	Devonian
Group	Traverse
Member	
Rock Type	limestone
Description	Tan to brown, to dark brown with abundant fossils in a fine grained limestone matrix.

Table 8-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	3.970E-06
Bulk specific gravity (oven dry)	2.58
Bulk specific gravity (saturated surface dry)	2.61
Apparent specific gravity	2.65
Absorption %	1.03
Average grain intercept length (µm)	21.7
Area % micro-pores	11.97
Average micro-pore diameter (µm)	1.70

Figure 8-1: Photo of 3/8" sieve fraction of 6AA product.

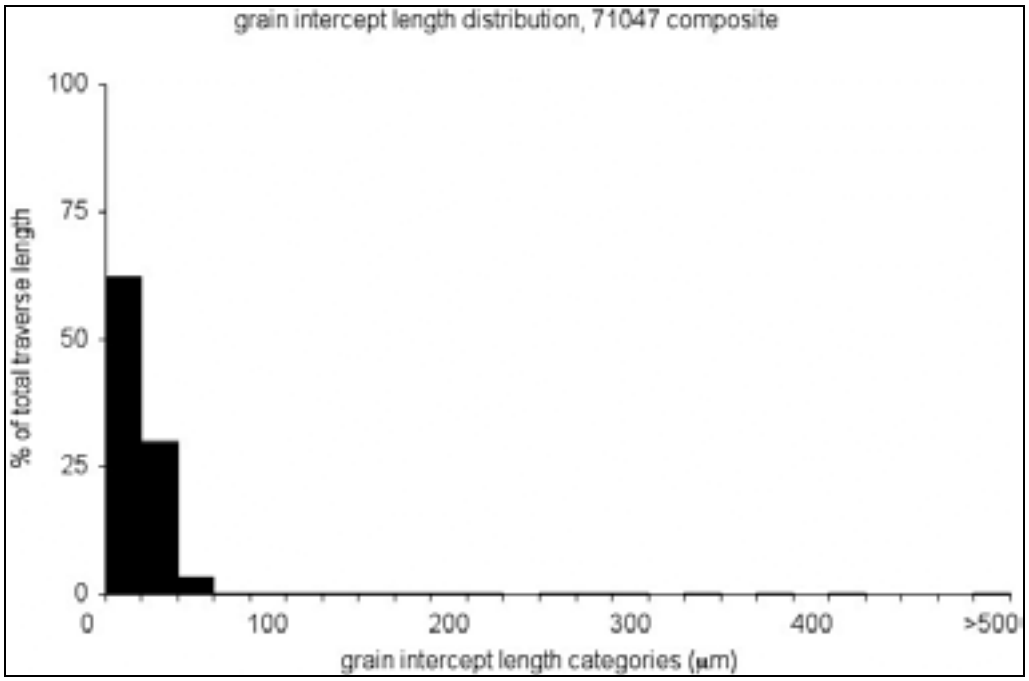


Figure 8-2: Grain intercept length distribution from petrographic microscope traverse.

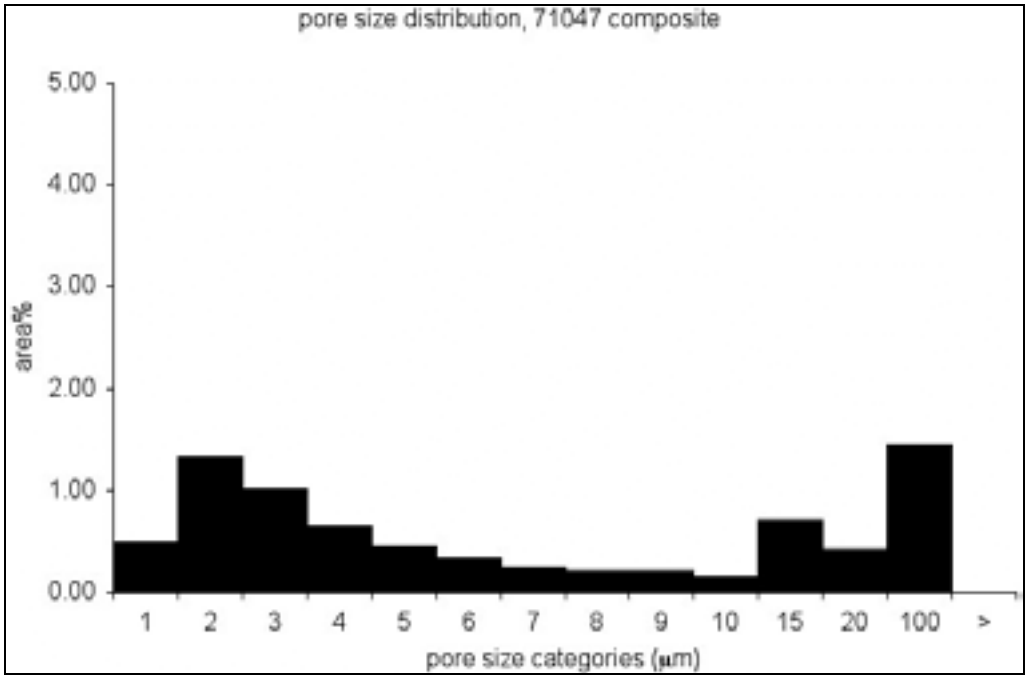


Figure 8-3: Micro-pore size distribution from back-scattered electron images.

Table 8-3: Data for grain intercept length distribution plot shown in Figure 8-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	62.21	62.21
20 to <40	29.89	92.10
40 to <60	3.28	95.38
60 to <80	0.28	95.66
80 to <100	0.35	96.01
100 to <120	0.28	96.29
120 to <140	0.38	96.67
140 to <160	0.24	96.91
160 to <180	0.36	97.27
180 to <200	0.21	97.48
200 to <220	0.31	97.79
220 to <240	0.15	97.94
240 to <280	0.32	98.26
280 to <300	0.21	98.47
300 to <320	0.15	98.63
320 to <340	0.06	98.69
340 to <360	0.25	98.94
360 to <380	0.13	99.07
380 to <400	0.31	99.38
400 to <420	0.07	99.45
420 to <440	0.16	99.61
440 to <460	0.06	99.67
460 to <480	0.12	99.78
480 to <500	0.06	99.84
500 and >	0.16	100.00

Table 8-4: Data for micro-pore size distribution plot shown in Figure 8-3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.49	6.39
1 to <2	1.34	23.74
2 to <3	1.02	36.93
3 to <4	0.65	45.40
4 to <5	0.46	51.34
5 to <6	0.33	55.63
6 to <7	0.24	58.81
7 to <8	0.21	61.52
8 to <9	0.21	64.27
9 to <10	0.16	66.31
10 to <15	0.72	75.62
15 to <20	0.42	81.12
20 to <100	1.45	100.00
100 and >	0.00	100.00
sum	7.70	

Table 8-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	1.00
Al_2O_3	0.10
SiO_2	0.54
S	0.07
CaO	54.25
Fe_2O_3	0.15
sum	56.11

Table 8-6: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	4.58
Calcite - $CaCO_3$	94.33
Pyrite - FeS_2	0.14
Other	0.54
sum	99.59

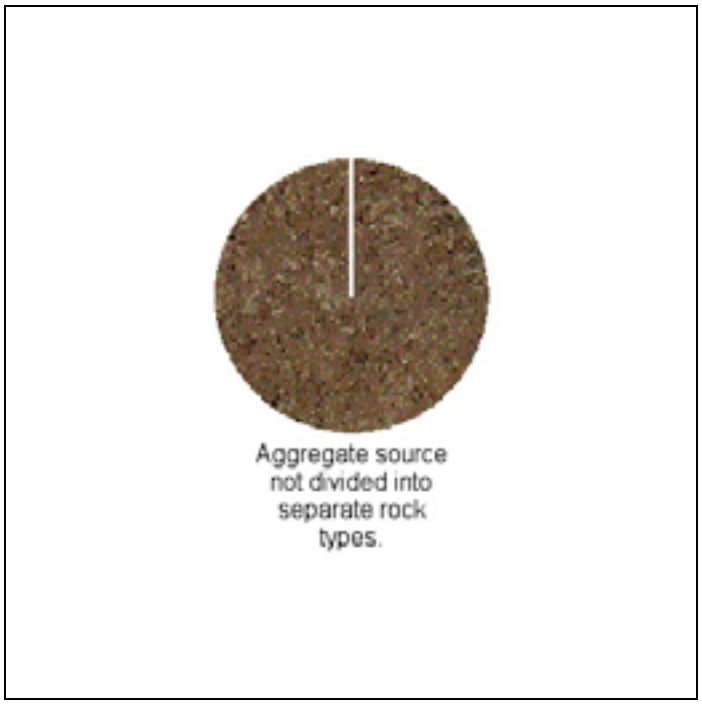


Figure 8-4: Rock types within aggregate source based on differences in color and texture.

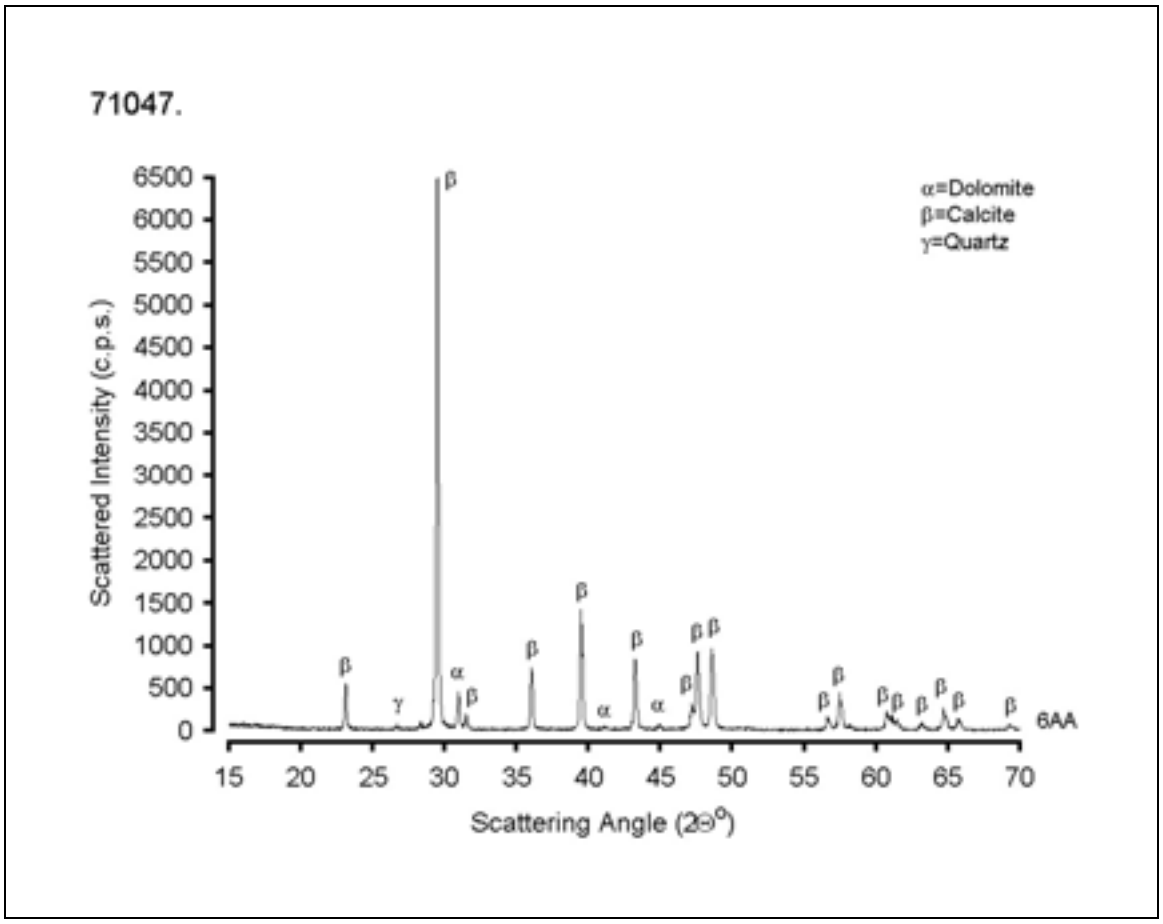


Figure 8-5: X-ray diffraction pattern from aggregate source.

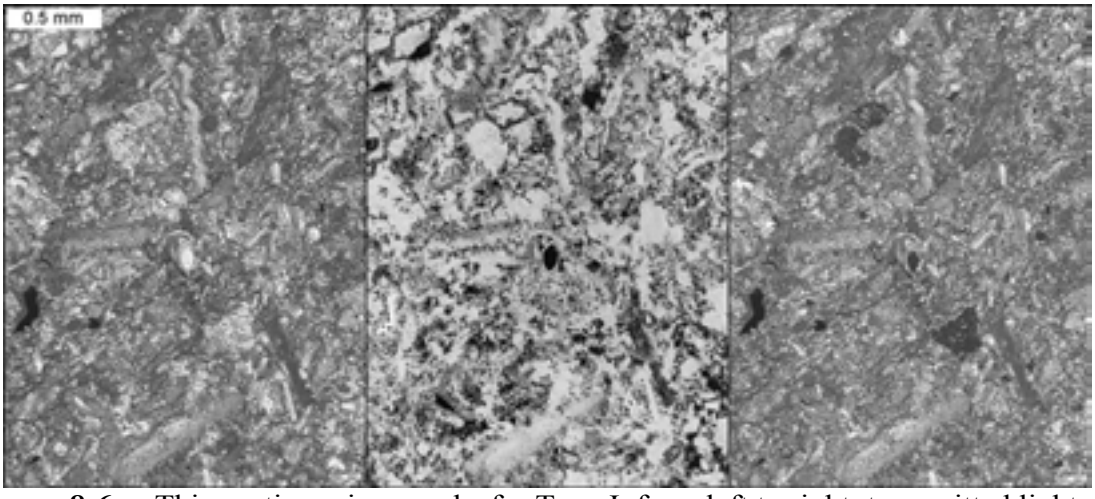


Figure 8-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

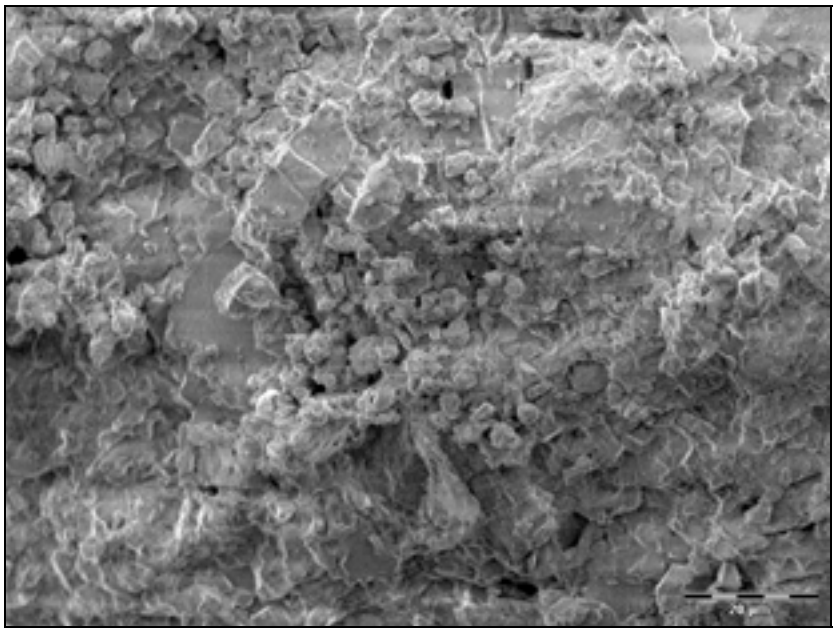


Figure 8-7a: ESEM photo of fracture surface.

Table 8-7: Grain intercept length statistics:

Grain intercept length (μm)	
Average	21.8
Median	10.6
Standard deviation	71.3
Maximum	2019.2
Minimum	2.8

Table 8-8: Micro-pore diameter statistics:

Micro-pore diameter (μm)	
Average	1.70
Median	1.17
Standard deviation	1.99
Maximum	56.58
Minimum	0.60

75005 - Port Inland

Table 9-1: Pit name, location, and general geologic information:

Pit Number	75005
Name	Port Inland
Longitude	-85.89
Latitude	45.98
Era	Palaeozoic
Period	Silurian
Group	Burnt Bluff
Member	
Rock Type	dolomitic limestone
Description	Light tan to tan fine grained limestone with frequent coarse grained calcite filled vugs and interspersed medium to coarse grained dolomite rhombs.

Table 9-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	4.401E-06
Bulk specific gravity (oven dry)	2.67
Bulk specific gravity (saturated surface dry)	2.68
Apparent specific gravity	2.71
Absorption %	0.59
Average grain intercept length (µm)	22.4
Area % micro-pores	7.08
Average micro-pore diameter (µm)	1.50

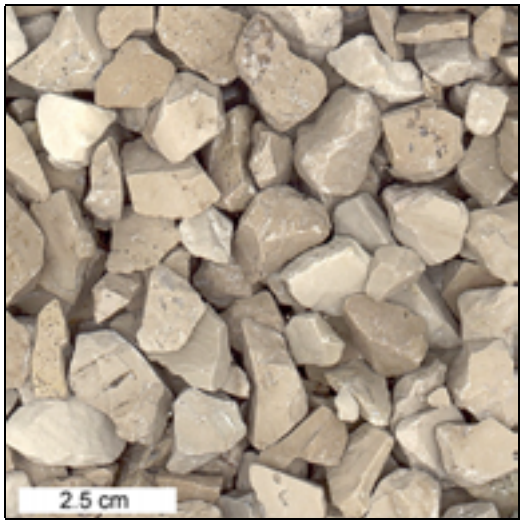


Figure 9- 1: Photo of 3/8" sieve fraction of 6AA product.

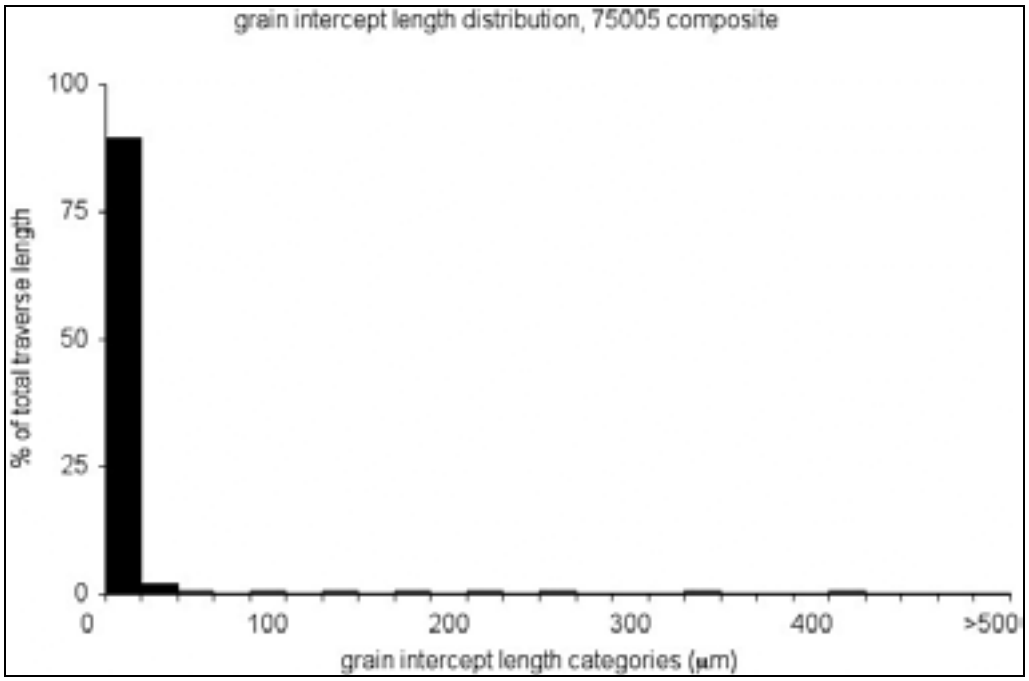


Figure 9- 2: Grain intercept length distribution from petrographic microscope traverse.

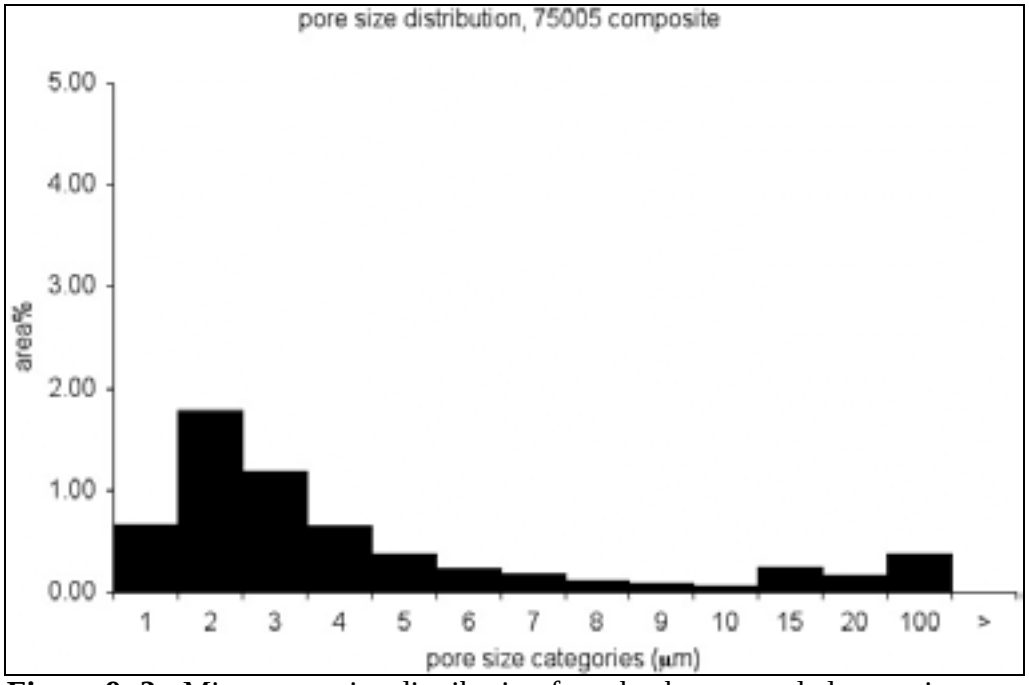


Figure 9- 3: Micro-pore size distribution from back-scattered electron images.

Table 9-3: Data for grain intercept length distribution plot shown in Figure 9- 2.

Size categories (µm)	% of total traverse length	Cumulative %
0 to <20	89.28	89.28
20 to <40	2.18	91.46
40 to <60	0.54	92.00
60 to <80	0.29	92.29
80 to <100	0.53	92.82
100 to <120	0.38	93.20
120 to <140	0.59	93.79
140 to <160	0.43	94.22
160 to <180	0.54	94.76
180 to <200	0.25	95.01
200 to <220	0.54	95.55
220 to <240	0.34	95.90
240 to <280	0.55	96.45
280 to <300	0.21	96.66
300 to <320	0.36	97.02
320 to <340	0.16	97.19
340 to <360	0.48	97.67
360 to <380	0.32	97.99
380 to <400	0.33	98.31
400 to <420	0.32	98.63
420 to <440	0.46	99.09
440 to <460	0.19	99.27
460 to <480	0.34	99.61
480 to <500	0.18	99.79
500 and >	0.21	100.00

Table 9-4: Data for micro-pore size distribution plot shown in Figure 9- 3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.66	10.73
1 to <2	1.79	39.83
2 to <3	1.19	59.19
3 to <4	0.65	69.76
4 to <5	0.38	75.93
5 to <6	0.22	79.54
6 to <7	0.18	82.43
7 to <8	0.13	84.48
8 to <9	0.09	85.96
9 to <10	0.07	87.02
10 to <15	0.25	91.07
15 to <20	0.17	93.88
20 to <100	0.38	100.00
100 and >	0.00	100.00
sum	6.15	

Table 9-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	1.59
Al_2O_3	0.24
SiO_2	0.94
S	0.03
CaO	53.08
Fe_2O_3	0.12
sum	56.00

Table 9-6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	7.27
Calcite - $CaCO_3$	90.79
Pyrite - FeS_2	0.06
Other	0.94
sum	99.07

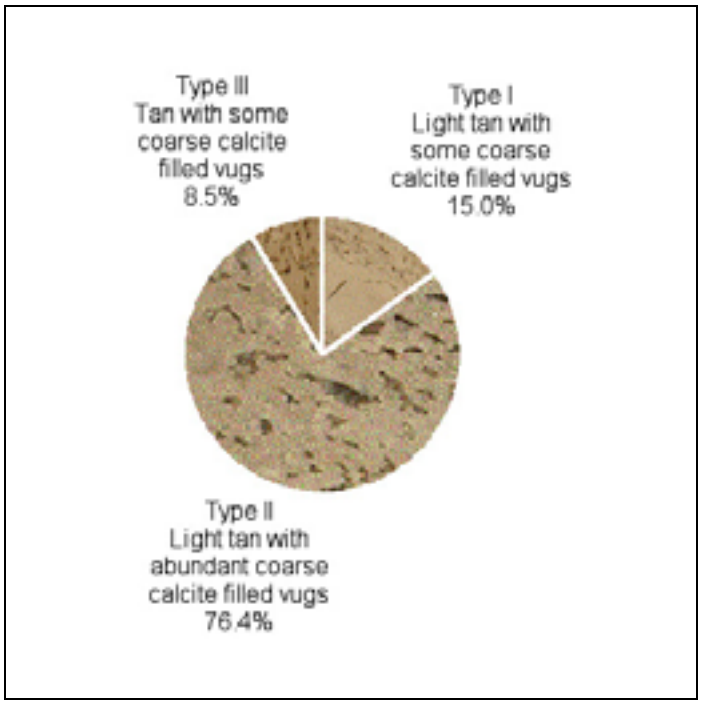


Figure 9- 4: Rock types within aggregate source based on differences in color and texture.

Table 9-7: Composition as determined by x-ray fluorescence, by type:

Oxide/element wt%	I	II	III
MgO	1.87	0.88	0.94
Al_2O_3	0.24	0.19	0.19
SiO_2	0.93	0.76	0.73
S	0.03	0.04	0.03
CaO	52.73	54.35	54.25
Fe_2O_3	0.21	0.11	0.11
sum	56.01	56.33	56.26

Table 9-8: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral wt%	I	II	III
Dolomite - $Ca,Mg(CO_3)_2$	8.54	4.04	4.29
Calcite - $CaCO_3$	89.48	94.81	94.50
Pyrite - FeS_2	0.06	0.07	0.06
Other	0.93	0.76	0.73
sum	99.00	99.68	99.58

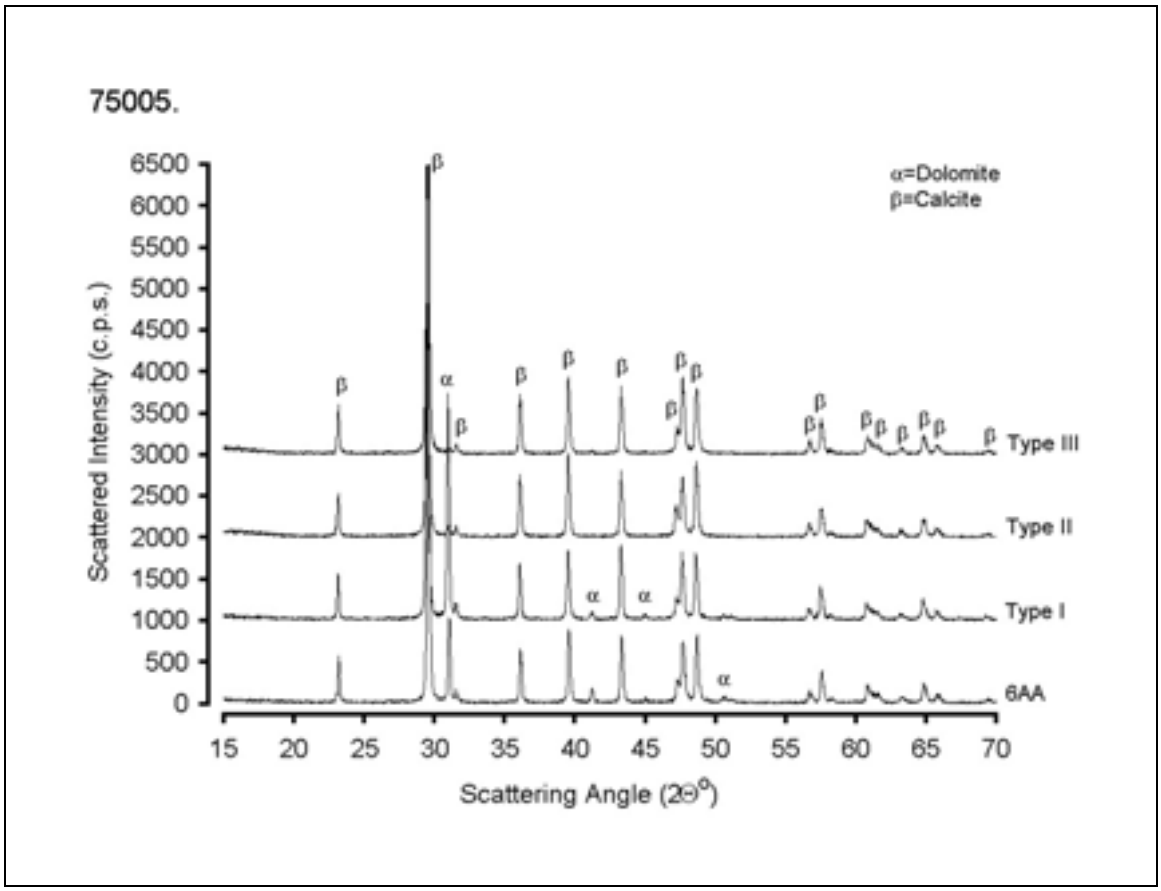


Figure 9-5: X-ray diffraction pattern from aggregate source.

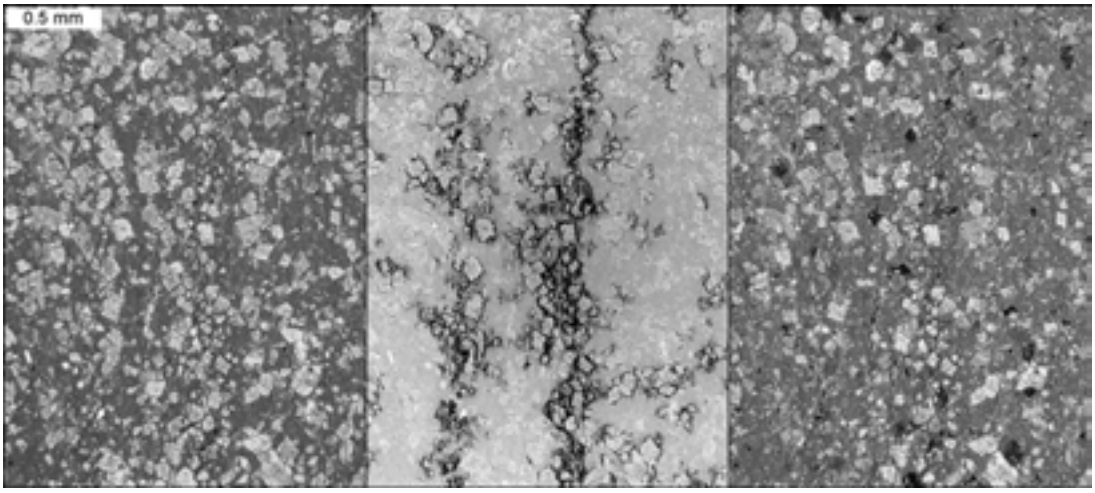


Figure 9-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

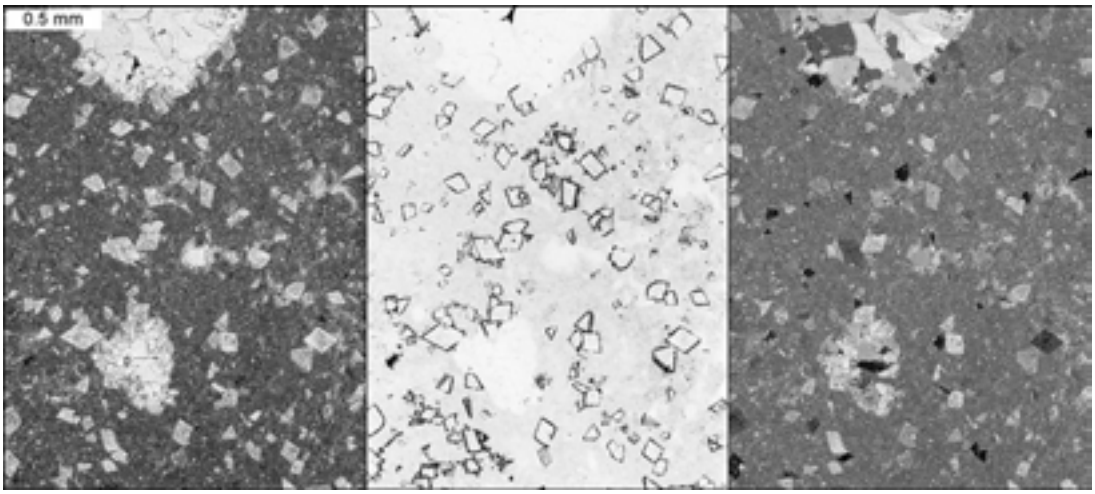


Figure 9-6b: Thin section micrographs for Type II, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

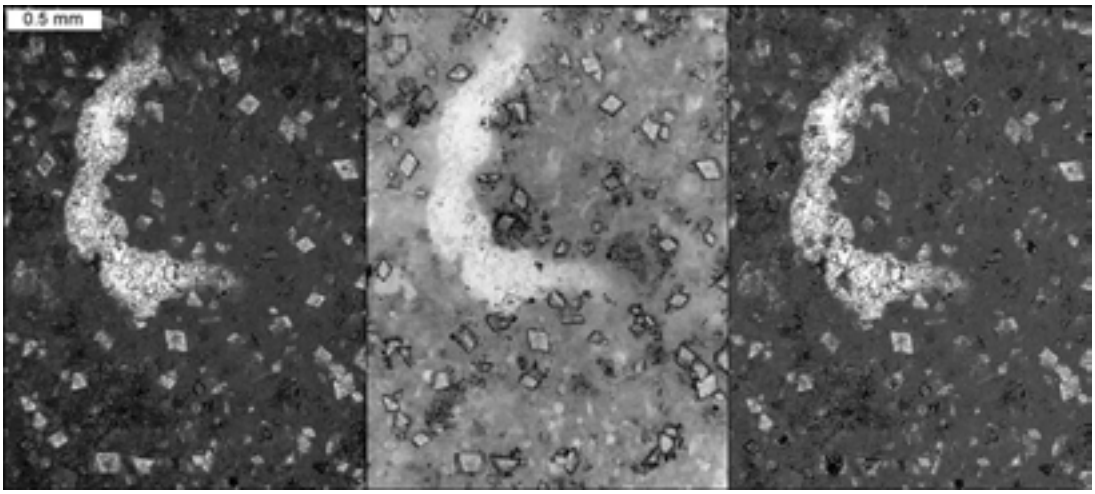


Figure 9-6c: Thin section micrographs for Type III, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

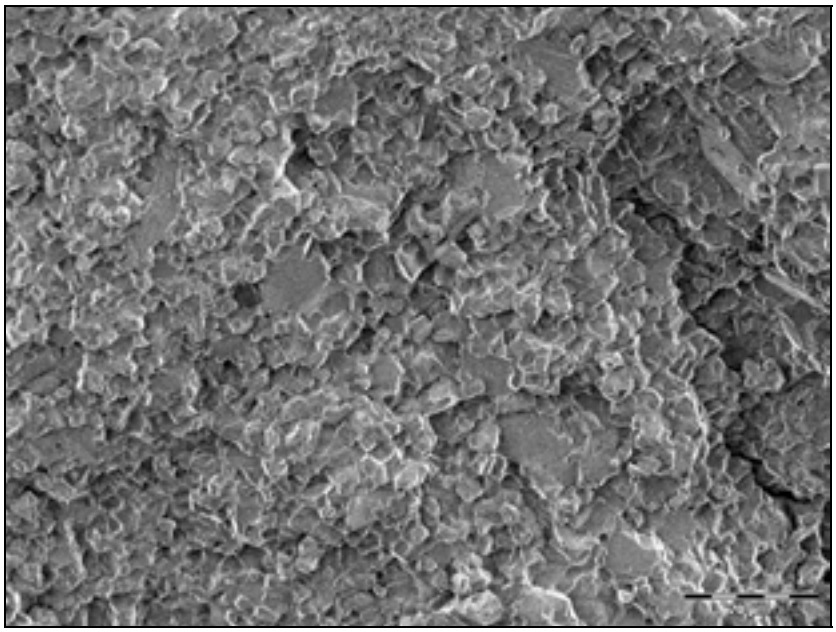


Figure 9-7a: ESEM photo of fracture surface for type I.

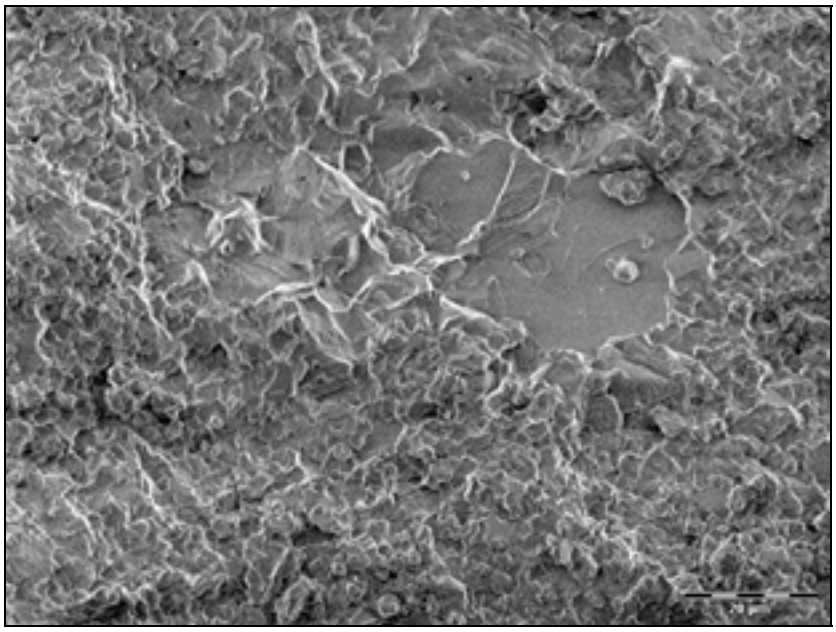


Figure 9-7b: ESEM photo of fracture surface for type II.

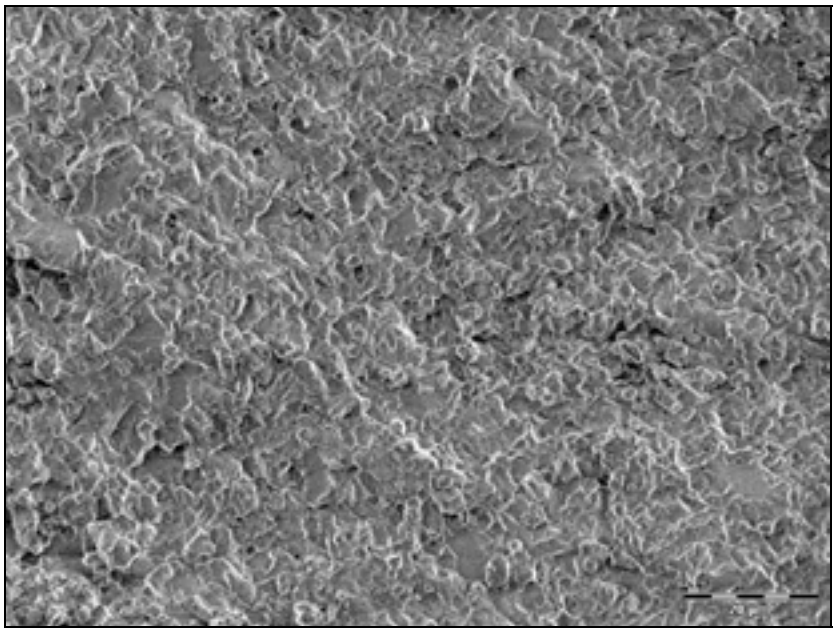


Figure 9-7c: ESEM photo of fracture surface for type III.

Table 9-9: Grain intercept length statistics, by type:

Grain intercept length (μm)	I	II	III
Average	38.9	19.2	25.2
Median	8.8	4.2	8.0
Standard deviation	96.4	76.4	77.3
Maximum	1209.6	1479.5	1265.2
Minimum	1.1	1.1	1.1

Table 9-10: Micro-pore diameter statistics, by type:

Micro-pore diameter (μm)	I	II	III
Average	1.59	1.50	1.41
Median	1.18	1.13	1.10
Standard deviation	1.37	1.55	1.24
Maximum	34.92	56.88	40.44
Minimum	0.60	0.60	0.60

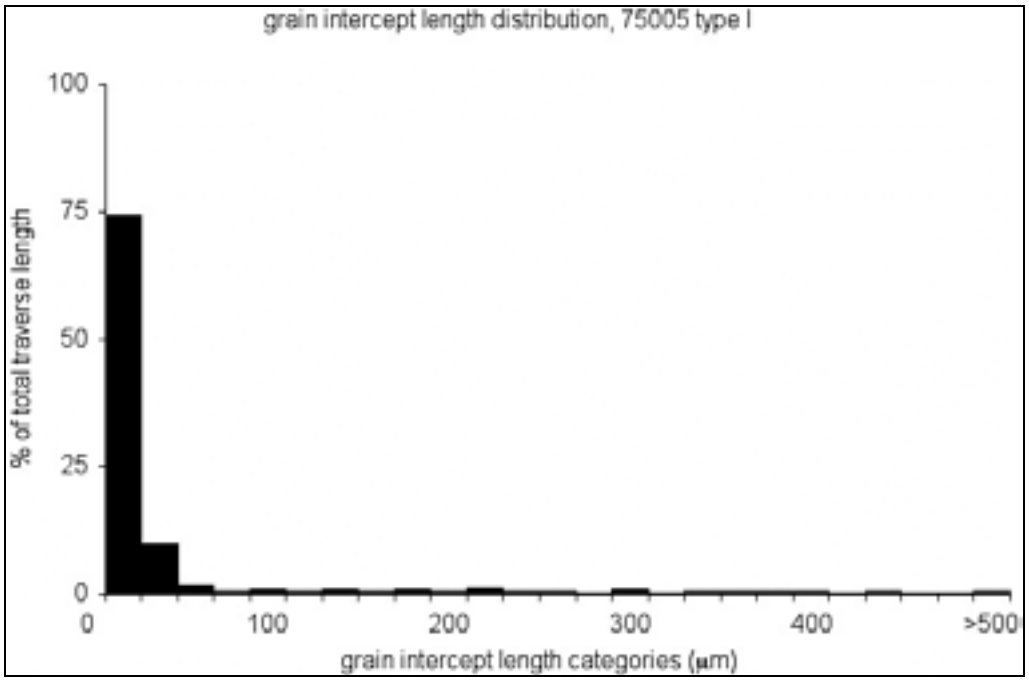


Figure 9- 8a: Grain intercept length distribution from petrographic microscope traverse, Type I.

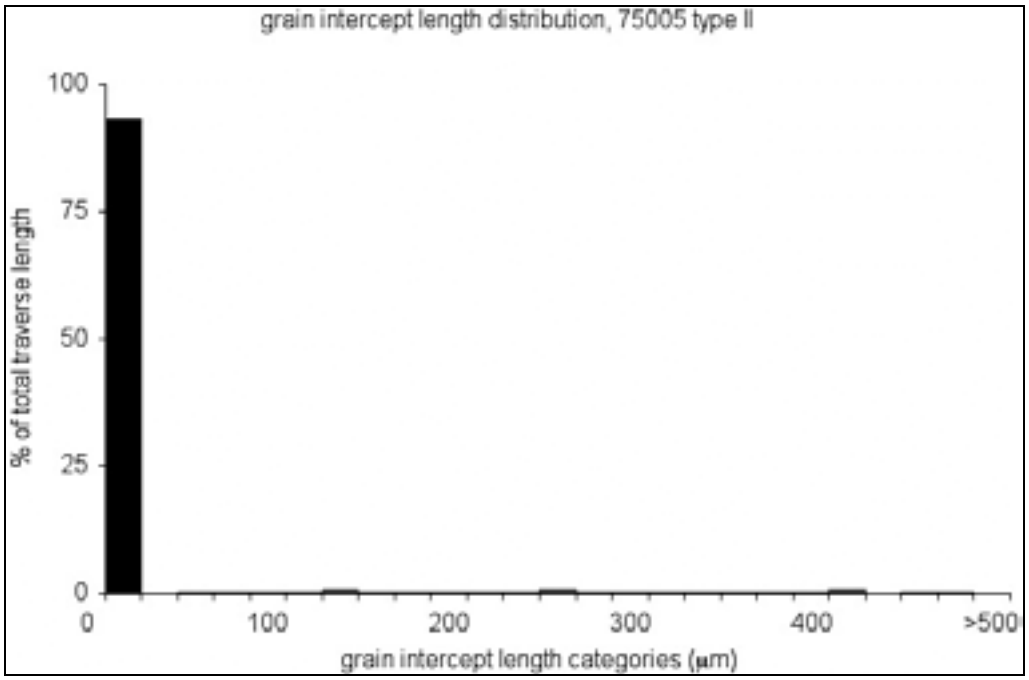


Figure 9- 8b: Grain intercept length distribution from petrographic microscope traverse, Type II.

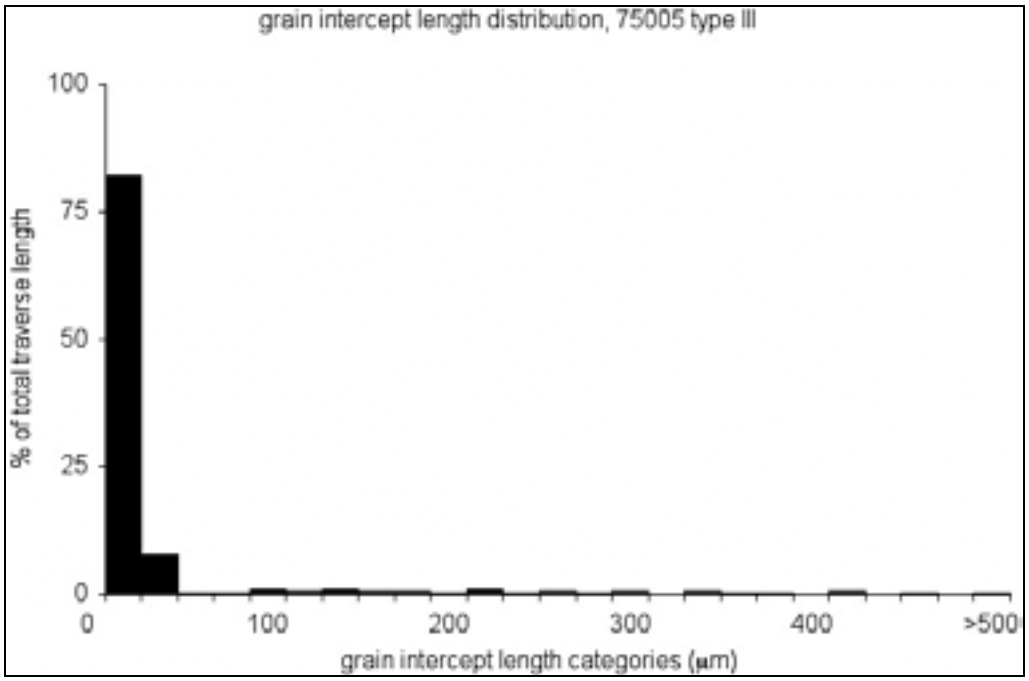


Figure 9- 8c: Grain intercept length distribution from petrographic microscope traverse, Type III.

Table 9-11a: Data for grain intercept length distribution plot shown in Figure 9- 8a, (type I):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	74.28	74.28
20 to <40	9.88	84.16
40 to <60	1.96	86.12
60 to <80	0.55	86.67
80 to <100	1.05	87.72
100 to <120	0.69	88.41
120 to <140	1.02	89.43
140 to <160	0.57	90.00
160 to <180	0.98	90.98
180 to <200	0.49	91.47
200 to <220	1.12	92.59
220 to <240	0.68	93.27
240 to <280	0.70	93.96
280 to <300	0.38	94.34
300 to <320	0.90	95.24
320 to <340	0.16	95.40
340 to <360	0.73	96.13
360 to <380	0.53	96.66
380 to <400	0.75	97.42
400 to <420	0.60	98.01
420 to <440	0.35	98.36
440 to <460	0.66	99.02
460 to <480	0.15	99.17
480 to <500	0.16	99.33
500 and >	0.67	100.00

Table 9-11b: Data for grain intercept length distribution plot shown in Figure 9- 8b, (type II):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	93.01	93.01
20 to <40	0.04	93.05
40 to <60	0.29	93.33
60 to <80	0.23	93.56
80 to <100	0.39	93.95
100 to <120	0.31	94.26
120 to <140	0.46	94.73
140 to <160	0.38	95.10
160 to <180	0.43	95.54
180 to <200	0.19	95.73
200 to <220	0.40	96.13
220 to <240	0.27	96.40
240 to <280	0.51	96.91
280 to <300	0.16	97.07
300 to <320	0.24	97.31
320 to <340	0.18	97.49
340 to <360	0.43	97.92
360 to <380	0.29	98.21
380 to <400	0.24	98.45
400 to <420	0.29	98.74
420 to <440	0.47	99.21
440 to <460	0.11	99.32
460 to <480	0.37	99.69
480 to <500	0.19	99.88
500 and >	0.12	100.00

Table 9-11c: Data for grain intercept length distribution plot shown in Figure 9- 8c, (type III):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	82.31	82.31
20 to <40	7.76	90.06
40 to <60	0.34	90.41
60 to <80	0.42	90.83
80 to <100	0.84	91.66
100 to <120	0.53	92.19
120 to <140	0.94	93.13
140 to <160	0.65	93.78
160 to <180	0.74	94.52
180 to <200	0.27	94.79
200 to <220	0.78	95.57
220 to <240	0.43	96.00
240 to <280	0.66	96.66
280 to <300	0.40	97.06
300 to <320	0.53	97.59
320 to <340	0.04	97.63
340 to <360	0.51	98.14
360 to <380	0.22	98.37
380 to <400	0.33	98.70
400 to <420	0.10	98.80
420 to <440	0.48	99.28
440 to <460	0.06	99.34
460 to <480	0.35	99.69
480 to <500	0.12	99.81
500 and >	0.19	100.00

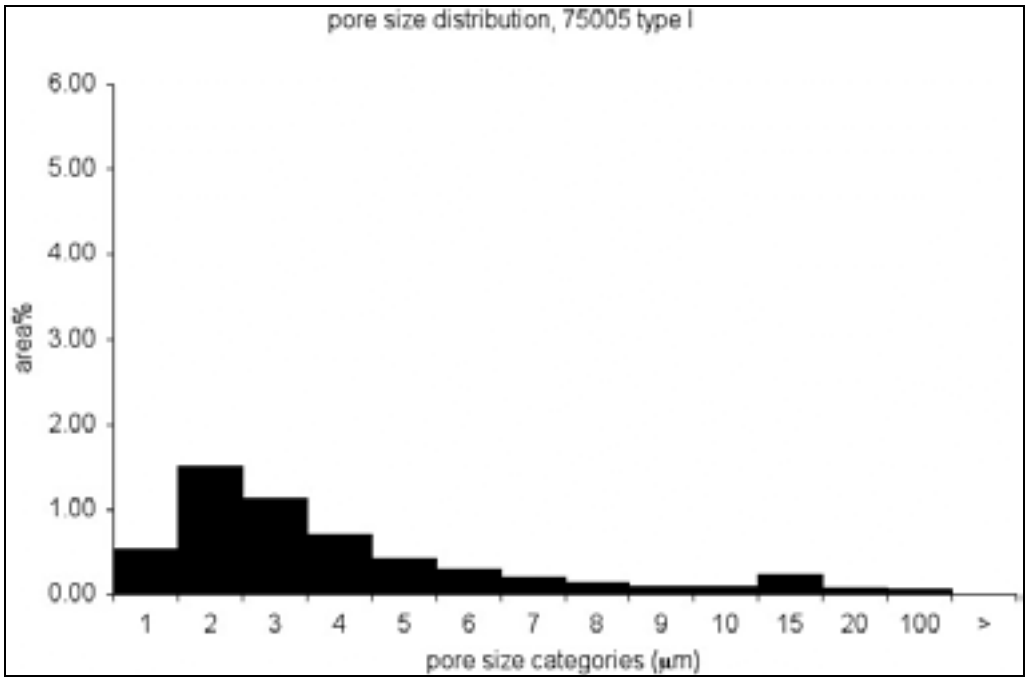


Figure 9- 9a: Micro-pore size distribution from back-scattered electron images, type I.

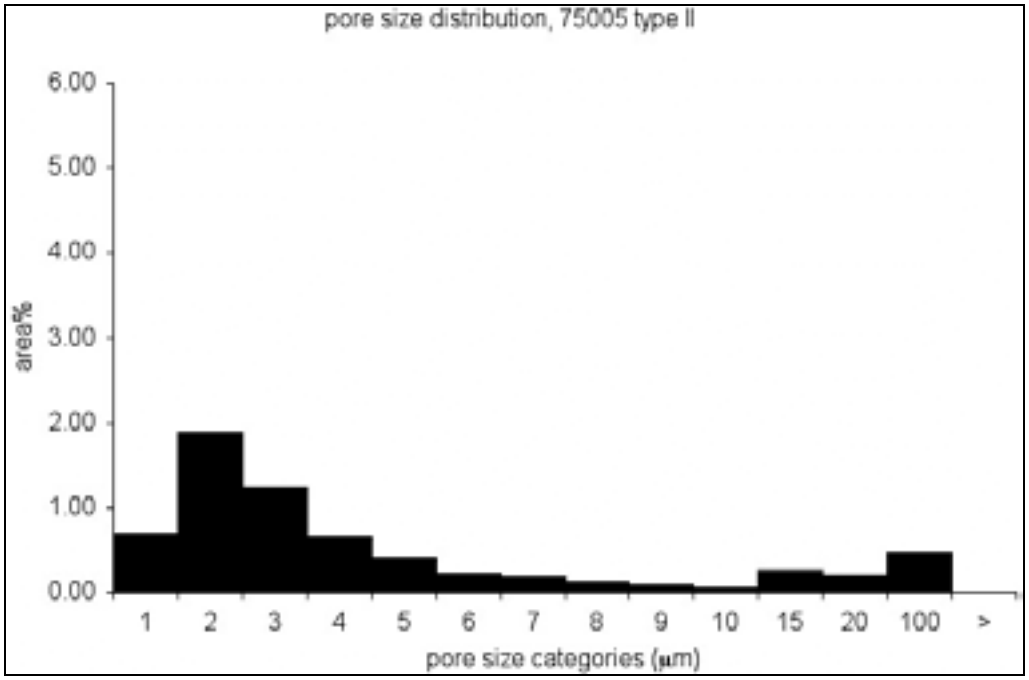


Figure 9- 9b: Micro-pore size distribution from back-scattered electron images, type II.

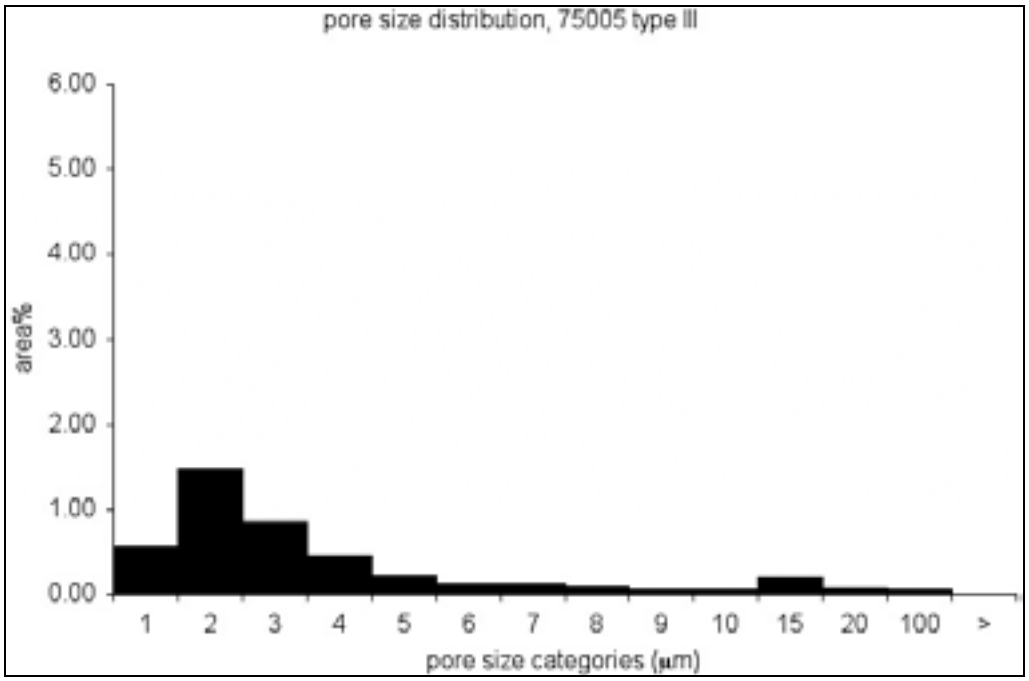


Figure 9- 9c: Micro-pore size distribution from back-scattered electron images, type III.

Table 9-12a: Data for micro-pore size distribution plot shown in Figure 9- 9a, (type I).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.53	9.76
1 to <2	1.50	37.27
2 to <3	1.13	57.85
3 to <4	0.71	70.91
4 to <5	0.41	78.40
5 to <6	0.28	83.57
6 to <7	0.20	87.17
7 to <8	0.15	89.88
8 to <9	0.09	91.61
9 to <10	0.08	93.11
10 to <15	0.24	97.45
15 to <20	0.08	98.91
20 to <100	0.06	100.00
100 and >	0.00	100.00
sum	5.47	

Table 9-12b: Data for micro-pore size distribution plot shown in Figure 9- 9b, (type II).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.69	10.71
1 to <2	1.88	39.70
2 to <3	1.24	58.82
3 to <4	0.66	69.01
4 to <5	0.39	75.06
5 to <6	0.22	78.46
6 to <7	0.18	81.24
7 to <8	0.13	83.18
8 to <9	0.09	84.63
9 to <10	0.06	85.59
10 to <15	0.26	89.56
15 to <20	0.20	92.70
20 to <100	0.47	100.00
100 and >	0.00	100.00
sum	6.49	

Table 9-12c: Data for micro-pore size distribution plot shown in Figure 9- 9c, (type III).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.57	13.16
1 to <2	1.48	47.24
2 to <3	0.86	67.02
3 to <4	0.45	77.33
4 to <5	0.21	82.22
5 to <6	0.13	85.11
6 to <7	0.12	87.89
7 to <8	0.09	89.87
8 to <9	0.06	91.28
9 to <10	0.06	92.64
10 to <15	0.19	97.07
15 to <20	0.06	98.55
20 to <100	0.06	100.00
100 and >	0.00	100.00
sum	4.33	

Table 9-13: Coefficient of thermal expansion, by type:

Type	Coefficient of thermal expansion (mm/mm/degree C):
I	5.20E-06
II	4.02E-06
III	3.80E-06

93002 - Maumee, Ohio

Table 10-1: Pit name, location, and general geologic information:

Pit Number	93002
Name	Maumee, Ohio
Longitude	-83.67
Latitude	41.58
Era	Palaeozoic
Period	Devonian
Group	Detroit River, Basswood Island
Member	
Rock Type	dolomite
Description	Gray to tan medium to coarse grained dolomite with frequent vugs.

Table 10-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	7.281E-06
Bulk specific gravity (oven dry)	2.66
Bulk specific gravity (saturated surface dry)	2.70
Apparent specific gravity	2.79
Absorption %	1.78
Average grain intercept length (µm)	89.9
Area % micro-pores	7.31
Average micro-pore diameter (µm)	1.87

Figure 10- 1: Photo of 3/8" sieve fraction of 6AA product.

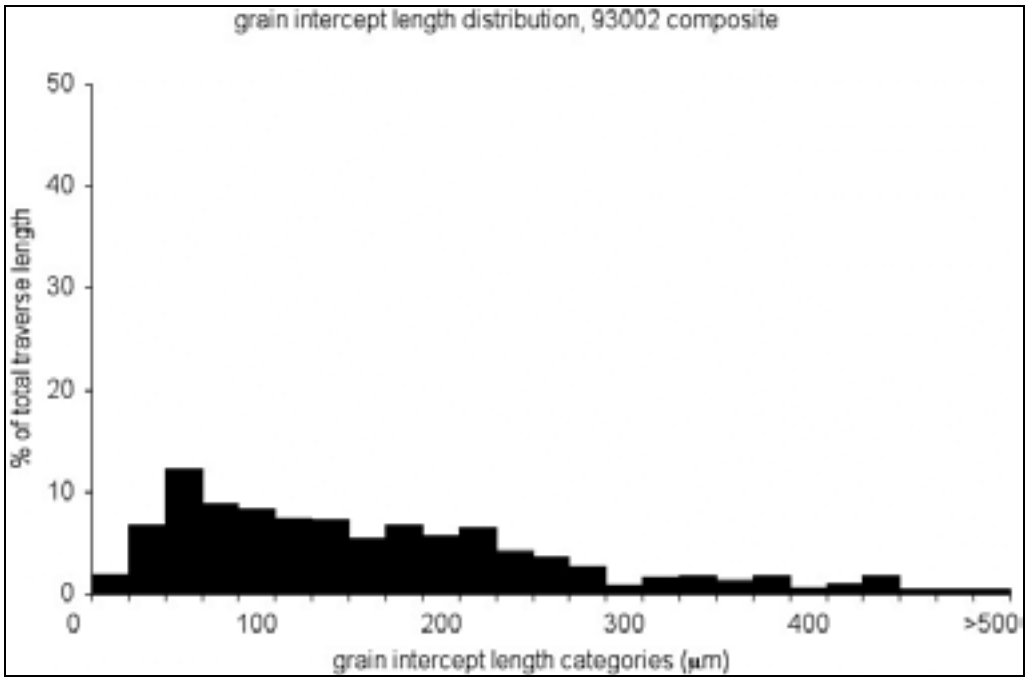


Figure 10- 2: Grain intercept length distribution from petrographic microscope traverse.

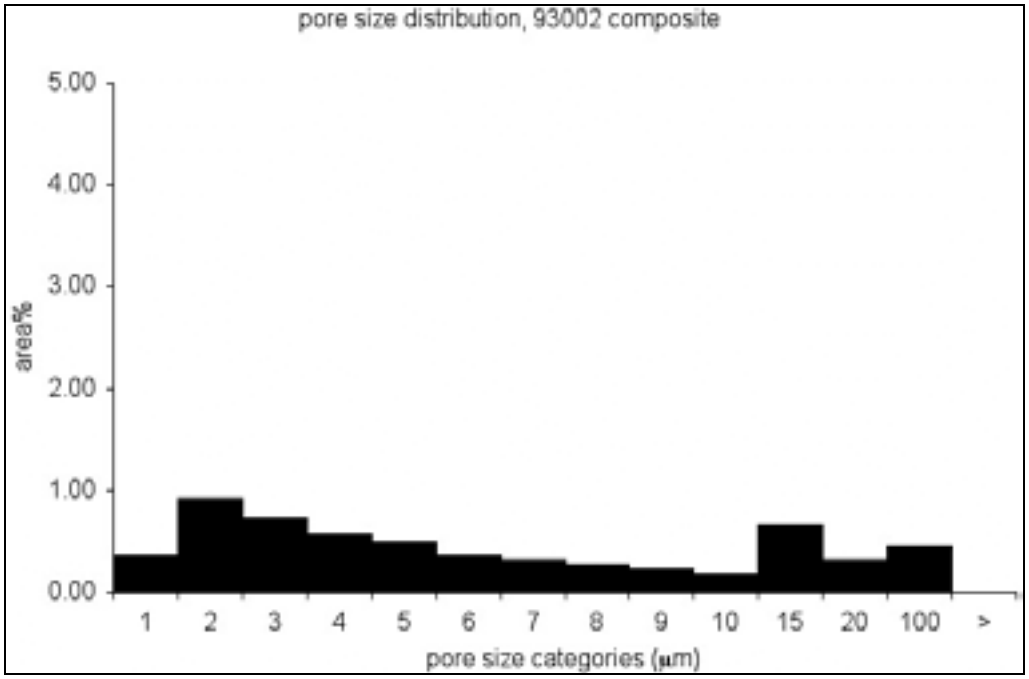


Figure 10- 3: Micro-pore size distribution from back-scattered electron images.

Table 10-3: Data for grain intercept length distribution plot shown in Figure 10- 2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	1.92	1.92
20 to <40	6.83	8.75
40 to <60	12.30	21.06
60 to <80	8.85	29.90
80 to <100	8.38	38.28
100 to <120	7.39	45.66
120 to <140	7.18	52.84
140 to <160	5.43	58.27
160 to <180	6.82	65.09
180 to <200	5.71	70.80
200 to <220	6.54	77.34
220 to <240	4.16	81.49
240 to <280	3.61	85.10
280 to <300	2.76	87.86
300 to <320	0.85	88.70
320 to <340	1.62	90.32
340 to <360	1.78	92.10
360 to <380	1.40	93.50
380 to <400	1.77	95.28
400 to <420	0.66	95.94
420 to <440	1.03	96.97
440 to <460	1.83	98.80
460 to <480	0.38	99.18
480 to <500	0.40	99.58
500 and >	0.42	100.00

Table 10-4: Data for micro-pore size distribution plot shown in Figure 10- 3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.37	6.24
1 to <2	0.93	22.01
2 to <3	0.73	34.34
3 to <4	0.58	44.17
4 to <5	0.49	52.53
5 to <6	0.36	58.73
6 to <7	0.32	64.15
7 to <8	0.27	68.72
8 to <9	0.22	72.45
9 to <10	0.19	75.66
10 to <15	0.66	86.84
15 to <20	0.31	92.18
20 to <100	0.46	100.00
100 and >	0.00	100.00
sum	5.88	

Table 10-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	21.48
Al_2O_3	0.06
SiO_2	0.24
S	0.04
CaO	30.73
Fe_2O_3	0.13
sum	52.68

Table 10-6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	98.29
Calcite - $CaCO_3$	1.50
Pyrite - FeS_2	0.07
Other	0.24
sum	100.10

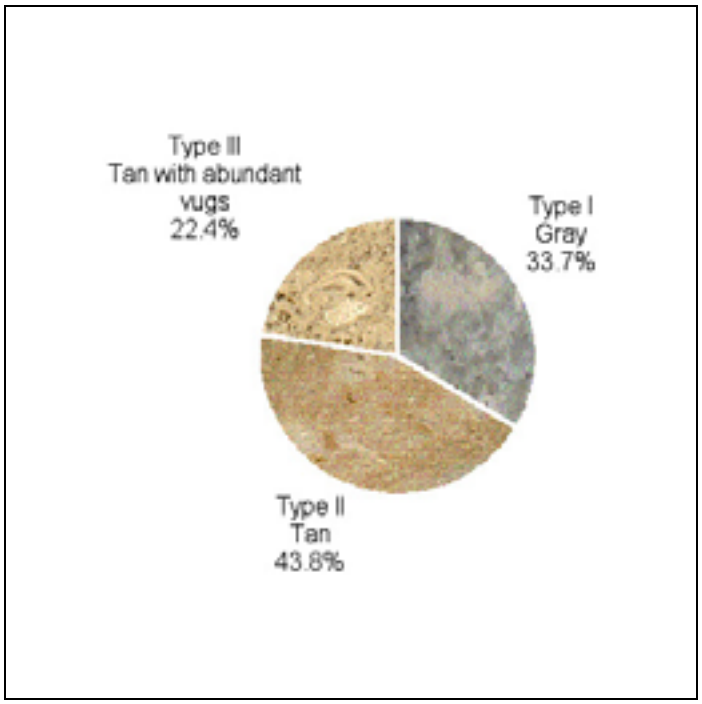


Figure 10- 4: Rock types within aggregate source based on differences in color and texture.

Table 10-7: Composition as determined by x-ray fluorescence, by type:

Oxide/element wt%	I	II	III
MgO	21.35	21.57	21.57
Al_2O_3	0.15	0.03	0.04
SiO_2	0.56	0.10	0.12
S	0.09	0.01	0.02
CaO	30.39	30.72	30.71
Fe_2O_3	0.30	0.10	0.13
sum	52.84	52.52	52.59

Table 10-8: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral wt%	I	II	III
Dolomite - $Ca,Mg(CO_3)_2$	97.67	98.67	98.69
Calcite - $CaCO_3$	1.23	1.27	1.24
Pyrite - FeS_2	0.16	0.02	0.04
Other	0.56	0.10	0.12
sum	99.62	100.06	100.09

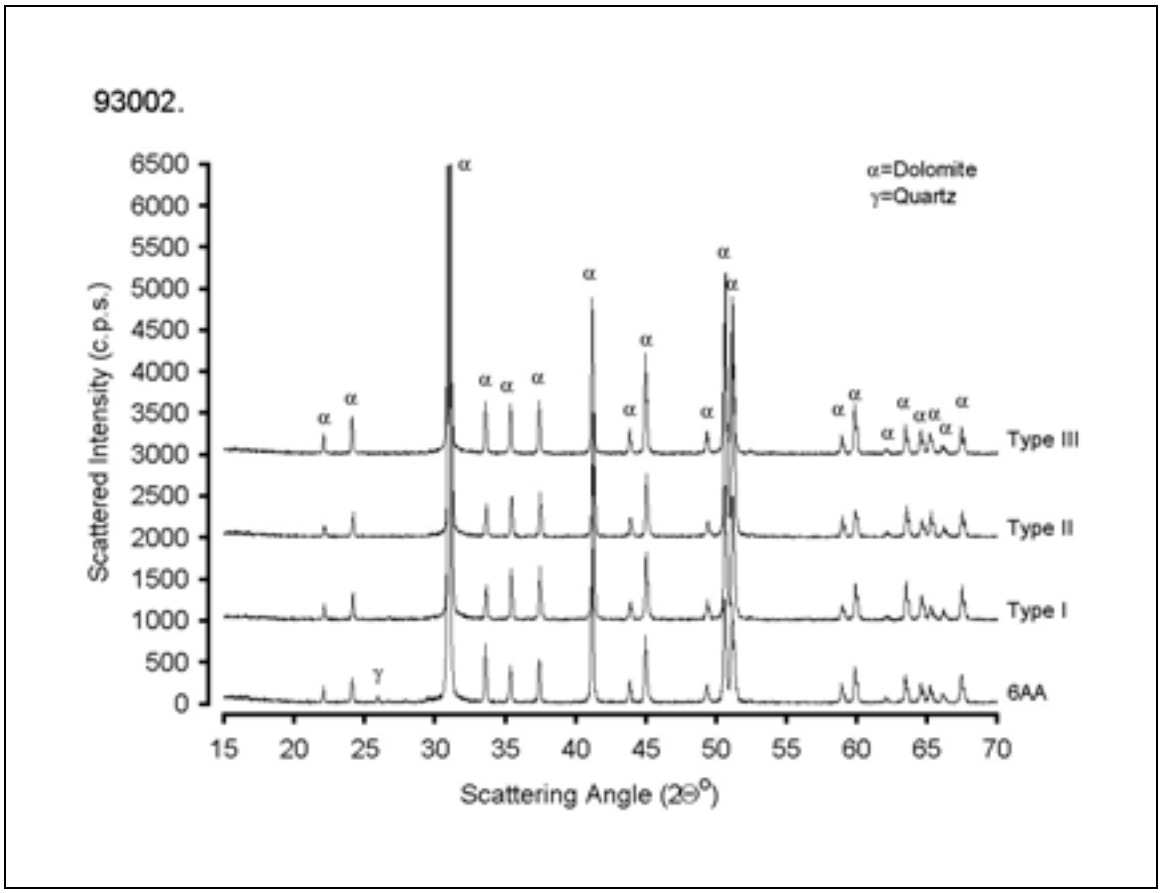


Figure 10-6: X-ray diffraction pattern from aggregate source.

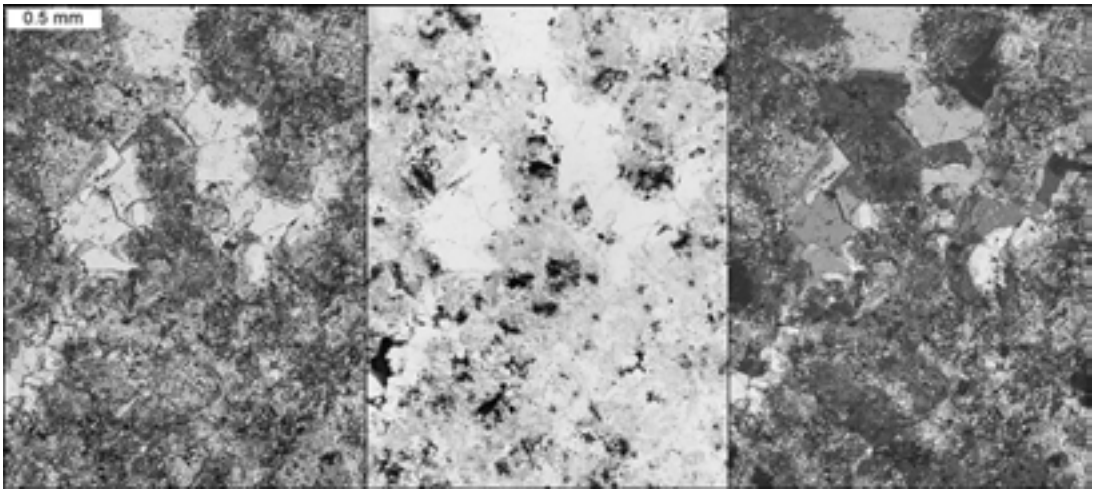


Figure 10-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

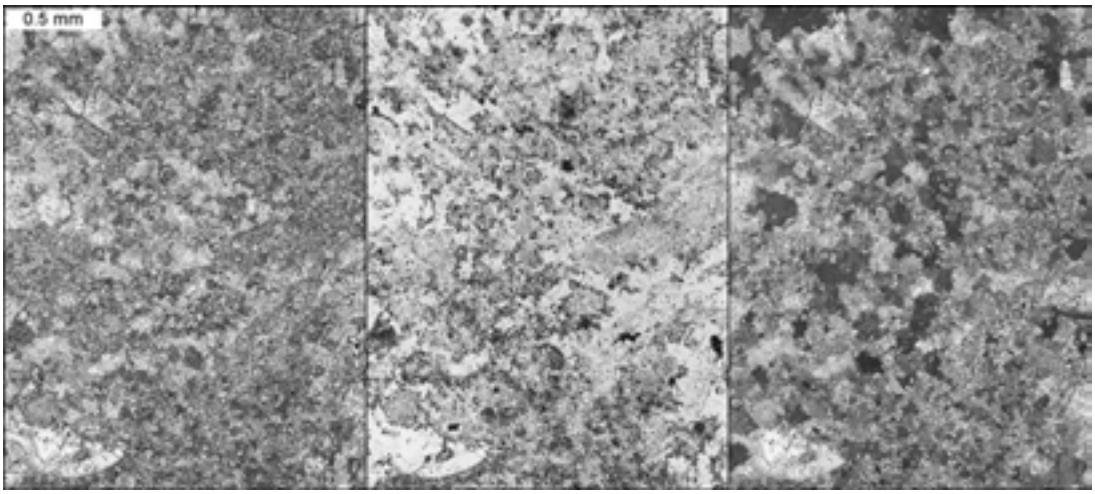


Figure 10-6b: Thin section micrographs for Type II, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

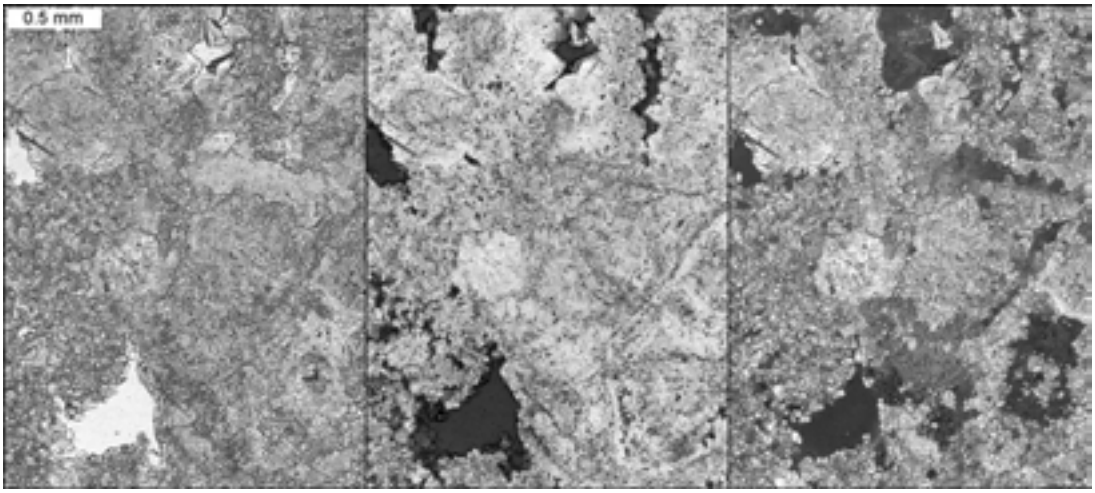


Figure 10-6c: Thin section micrographs for Type III, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

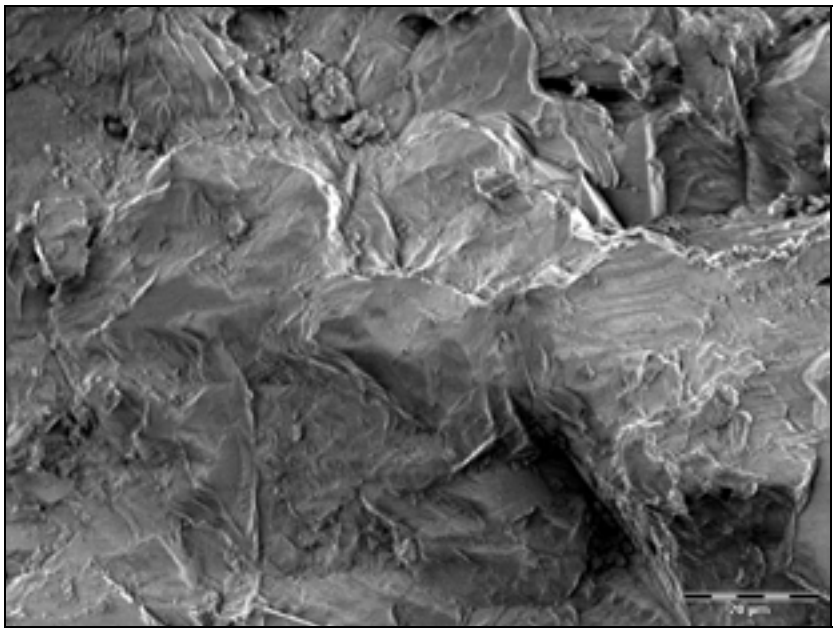


Figure 10-7a: ESEM photo of fracture surface for type I.

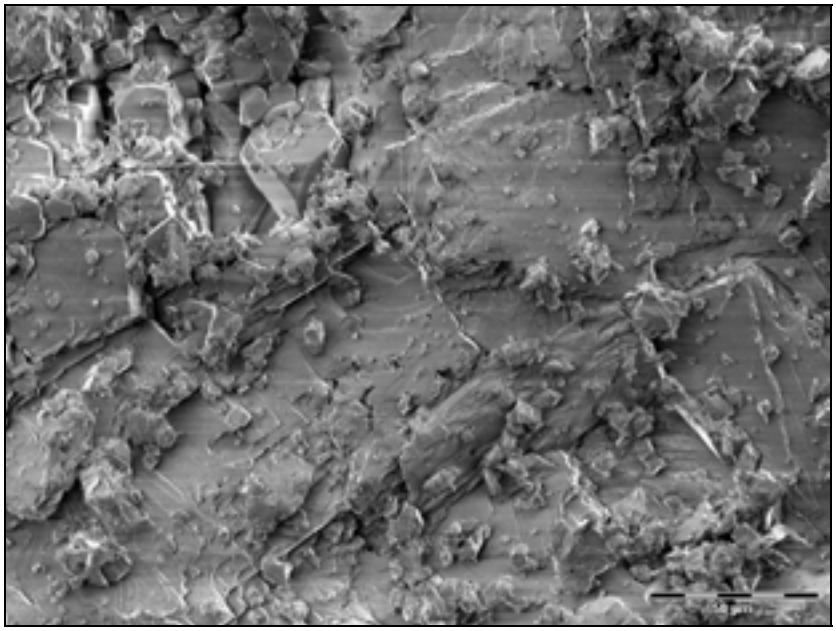


Figure 10-7b: ESEM photo of fracture surface for type II.

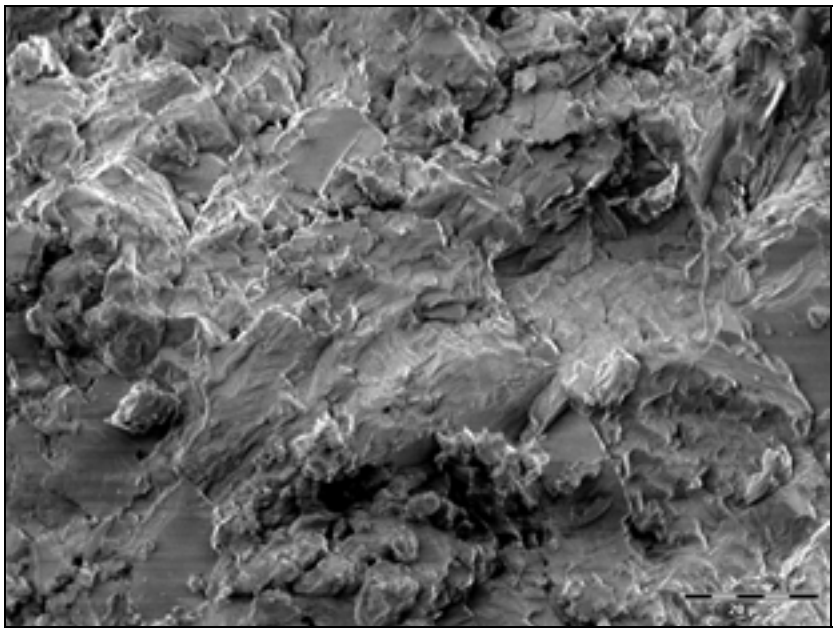


Figure 10-7c: ESEM photo of fracture surface for type III.

Table 10-9: Grain intercept length statistics, by type:

Grain intercept length (μm)	I	II	III
Average	78.4	97.8	91.8
Median	60.0	60.0	60.0
Standard deviation	65.6	92.6	106.1
Maximum	550.3	604.7	923.8
Minimum	9.4	5.5	5.5

Table 10-10: Micro-pore diameter statistics, by type:

Micro-pore diameter (μm)	I	II	III
Average	1.62	2.03	1.92
Median	1.15	1.26	1.18
Standard deviation	1.40	2.37	2.27
Maximum	27.63	45.52	34.42
Minimum	0.60	0.60	0.60

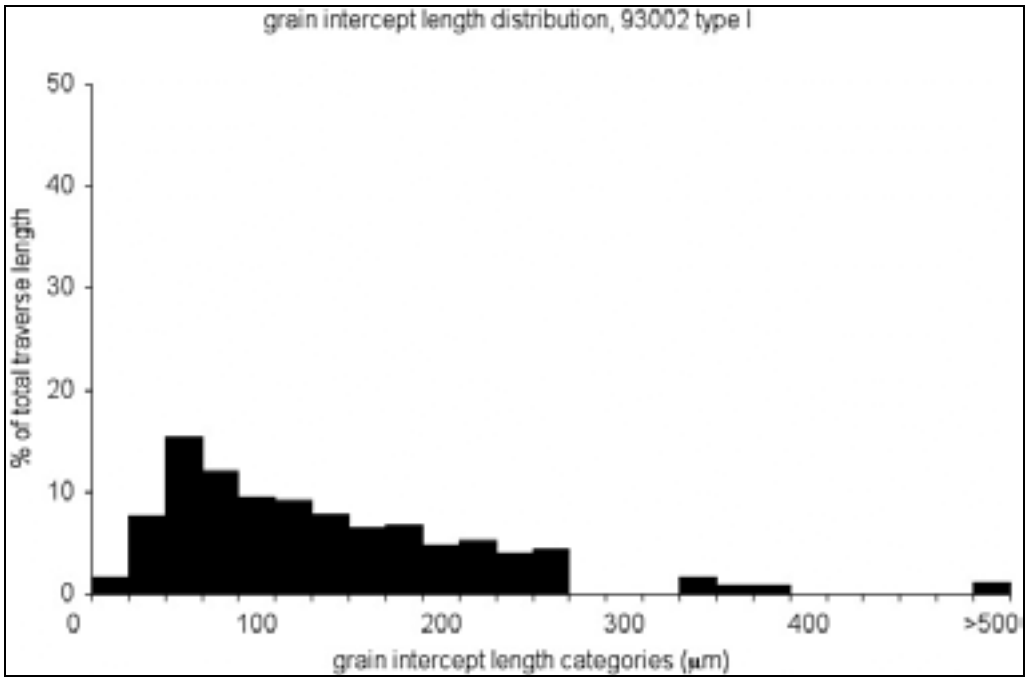


Figure 10-8a: Grain intercept length distribution from petrographic microscope traverse, Type I.

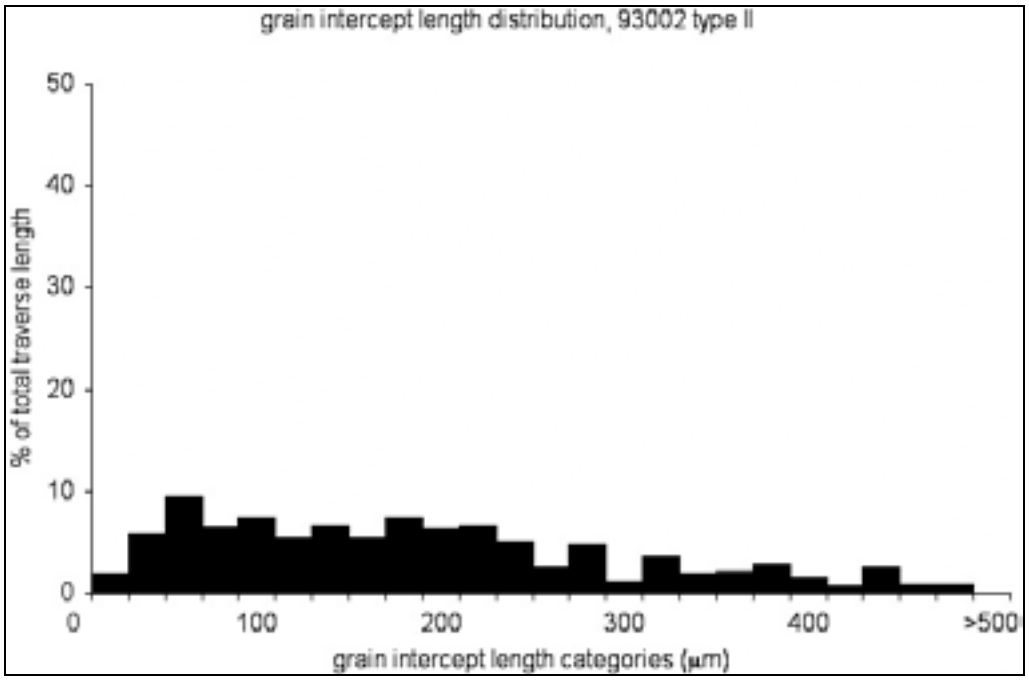


Figure 10-8b: Grain intercept length distribution from petrographic microscope traverse, Type II.

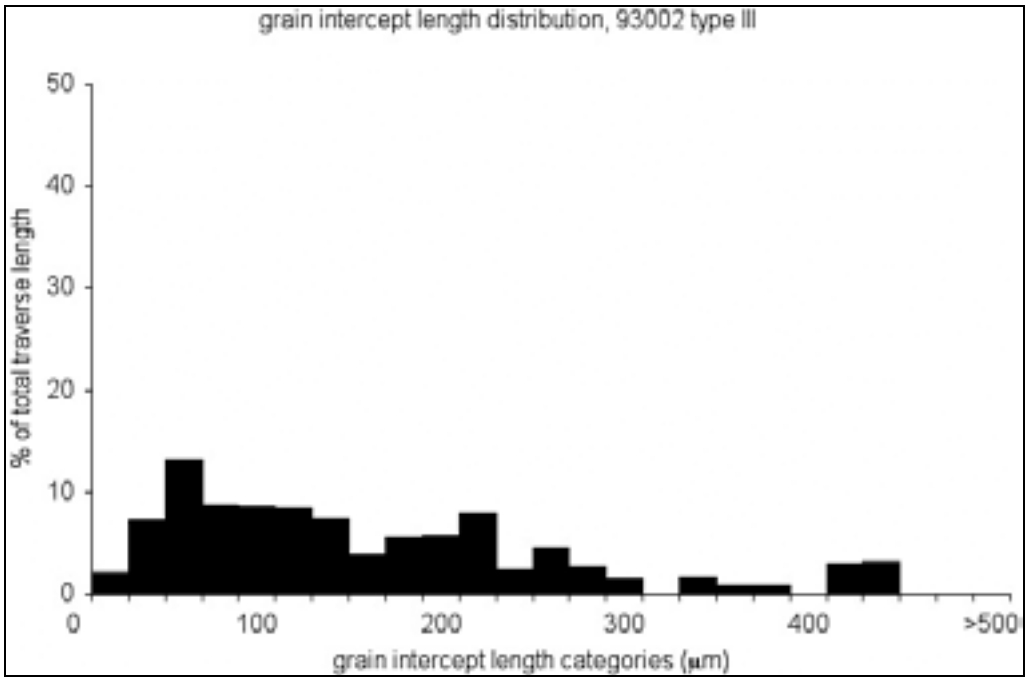


Figure 10-8c: Grain intercept length distribution from petrographic microscope traverse, Type III.

Table 10-11a: Data for grain intercept length distribution plot shown in Figure 10-8a, (type I):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	1.71	1.71
20 to <40	7.70	9.41
40 to <60	15.35	24.76
60 to <80	12.06	36.83
80 to <100	9.57	46.40
100 to <120	9.23	55.62
120 to <140	7.82	63.44
140 to <160	6.44	69.88
160 to <180	6.85	76.73
180 to <200	4.77	81.51
200 to <220	5.33	86.84
220 to <240	4.08	90.92
240 to <280	4.43	95.34
280 to <300	0.00	95.34
300 to <320	0.00	95.34
320 to <340	0.00	95.34
340 to <360	1.63	96.97
360 to <380	0.87	97.84
380 to <400	0.92	98.76
400 to <420	0.00	98.76
420 to <440	0.00	98.76
440 to <460	0.00	98.76
460 to <480	0.00	98.76
480 to <500	0.00	98.76
500 and >	1.24	100.00

Table 10-11b: Data for grain intercept length distribution plot shown in Figure 10-8b, (type II):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	2.00	2.00
20 to <40	5.92	7.92
40 to <60	9.50	17.42
60 to <80	6.45	23.87
80 to <100	7.35	31.22
100 to <120	5.40	36.62
120 to <140	6.57	43.19
140 to <160	5.43	48.63
160 to <180	7.40	56.03
180 to <200	6.38	62.40
200 to <220	6.69	69.09
220 to <240	5.12	74.21
240 to <280	2.50	76.71
280 to <300	4.89	81.60
300 to <320	1.16	82.76
320 to <340	3.69	86.45
340 to <360	1.97	88.42
360 to <380	2.07	90.49
380 to <400	2.88	93.36
400 to <420	1.51	94.87
420 to <440	0.82	95.69
440 to <460	2.53	98.22
460 to <480	0.87	99.09
480 to <500	0.91	100.00
500 and >	0.00	100.00

Table 10-11c: Data for grain intercept length distribution plot shown in Figure 10-8c, (type III):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	2.09	2.09
20 to <40	7.29	9.38
40 to <60	13.20	22.58
60 to <80	8.70	31.28
80 to <100	8.58	39.86
100 to <120	8.48	48.34
120 to <140	7.41	55.75
140 to <160	3.89	59.65
160 to <180	5.65	65.30
180 to <200	5.80	71.10
200 to <220	8.05	79.15
220 to <240	2.39	81.54
240 to <280	4.54	86.07
280 to <300	2.76	88.83
300 to <320	1.50	90.33
320 to <340	0.00	90.33
340 to <360	1.65	91.98
360 to <380	0.88	92.86
380 to <400	0.90	93.77
400 to <420	0.00	93.77
420 to <440	3.01	96.78
440 to <460	3.22	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

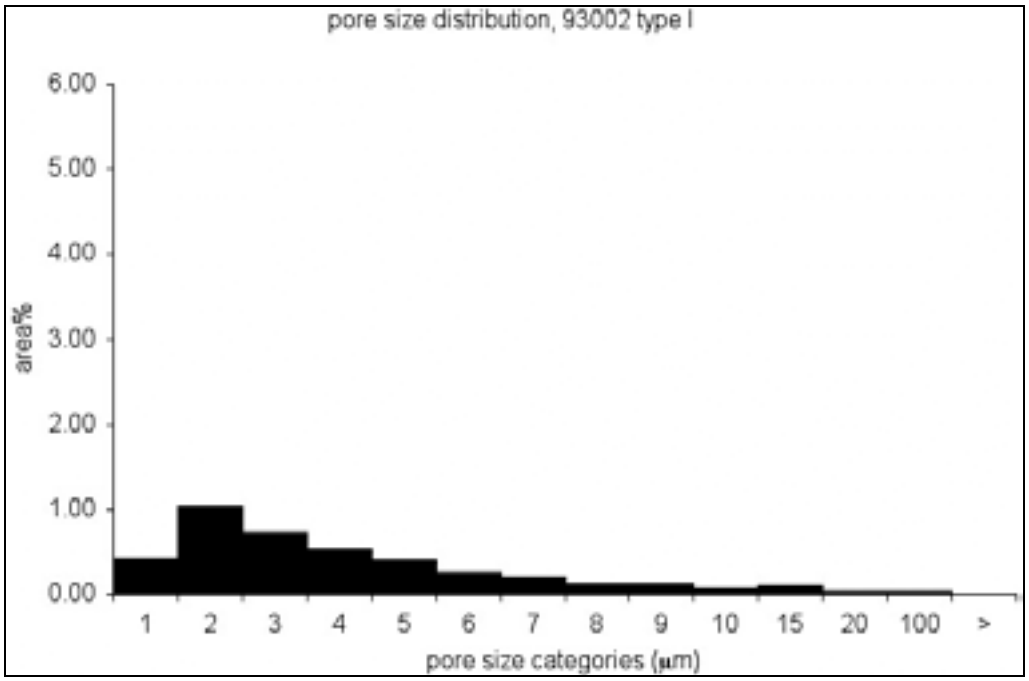


Figure 10-9a: Micro-pore size distribution from back-scattered electron images, type I.

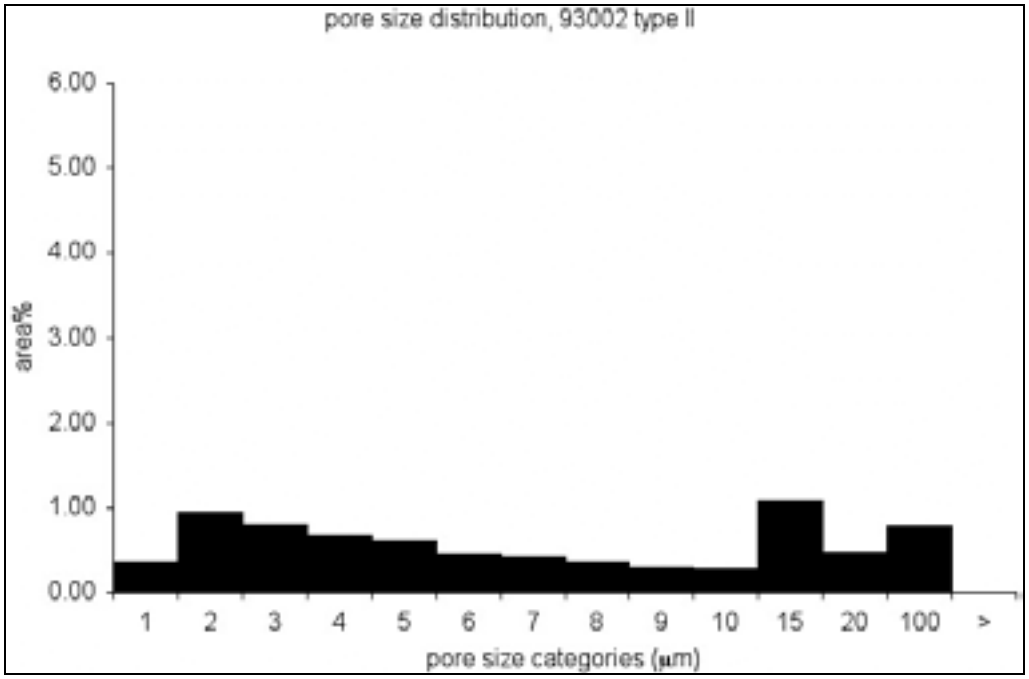


Figure 10-9b: Micro-pore size distribution from back-scattered electron images, type II.

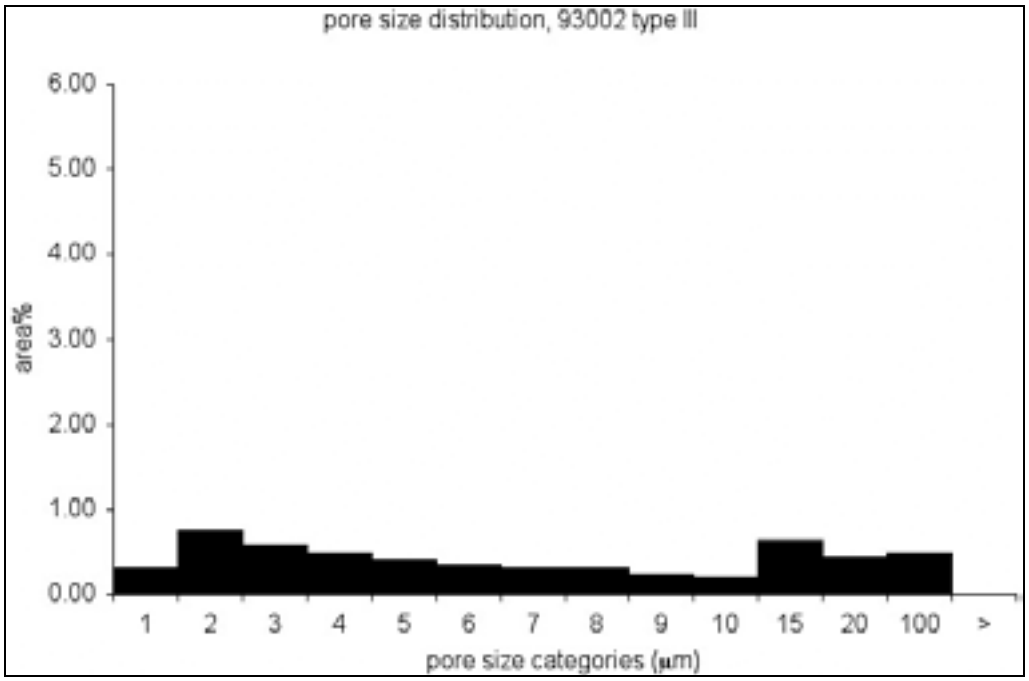


Figure 10-9c: Micro-pore size distribution from back-scattered electron images, type III.

Table 10-12a: Data for micro-pore size distribution plot shown in Figure 10-9a, (type I).

Size categories (µm)	Area %	Cumulative %
0 to <1	0.41	10.16
1 to <2	1.03	35.77
2 to <3	0.73	53.87
3 to <4	0.52	66.68
4 to <5	0.40	76.52
5 to <6	0.25	82.81
6 to <7	0.19	87.57
7 to <8	0.12	90.61
8 to <9	0.13	93.82
9 to <10	0.07	95.48
10 to <15	0.11	98.22
15 to <20	0.04	99.10
20 to <100	0.04	100.00
100 and >	0.00	100.00
sum	4.04	

Table 10-12b: Data for micro-pore size distribution plot shown in Figure 10-9b, (type II).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.36	4.85
1 to <2	0.94	17.41
2 to <3	0.79	27.99
3 to <4	0.67	36.87
4 to <5	0.61	45.03
5 to <6	0.46	51.13
6 to <7	0.42	56.77
7 to <8	0.36	61.63
8 to <9	0.28	65.37
9 to <10	0.27	69.01
10 to <15	1.09	83.51
15 to <20	0.47	89.72
20 to <100	0.77	100.00
100 and >	0.00	100.00
sum	7.51	

Table 10-12c: Data for micro-pore size distribution plot shown in Figure 10-9c, (type III).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.31	5.60
1 to <2	0.74	19.07
2 to <3	0.58	29.70
3 to <4	0.50	38.75
4 to <5	0.40	46.02
5 to <6	0.35	52.41
6 to <7	0.30	57.95
7 to <8	0.30	63.44
8 to <9	0.23	67.71
9 to <10	0.21	71.48
10 to <15	0.64	83.13
15 to <20	0.44	91.11
20 to <100	0.49	100.00
100 and >	0.00	100.00
sum	5.48	

Table 10-13: Coefficient of thermal expansion, by type:

Type	Coefficient of thermal expansion (mm/mm/degree C):
I	7.91E-06
II	6.84E-06
III	7.19E-06

93003 - Sylvania, Ohio

Table 11-1: Pit name, location, and general geologic information:

Pit Number	93003
Name	Sylvania, Ohio
Longitude	-83.75
Latitude	41.70
Era	Palaeozoic
Period	Devonian
Group	Detroit River, Basswood Island
Member	
Rock Type	calcareous dolomite
Description	Tan to dark brown/gray medium to coarse grained dolomite.

Table 11-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	7.780E-06
Bulk specific gravity (oven dry)	2.59
Bulk specific gravity (saturated surface dry)	2.65
Apparent specific gravity	2.75
Absorption %	2.29
Average grain intercept length (µm)	92.8
Area % micro-pores	14.71
Average micro-pore diameter (µm)	1.95

Figure 11-1: Photo of 3/8" sieve fraction of 6AA product.

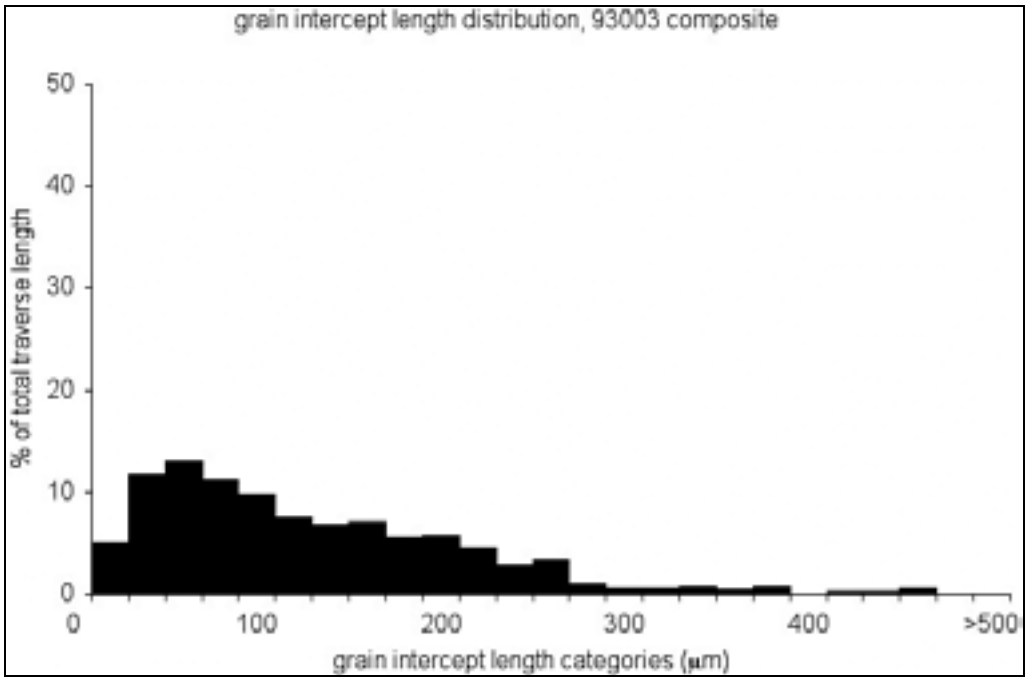


Figure 11-2: Grain intercept length distribution from petrographic microscope traverse.

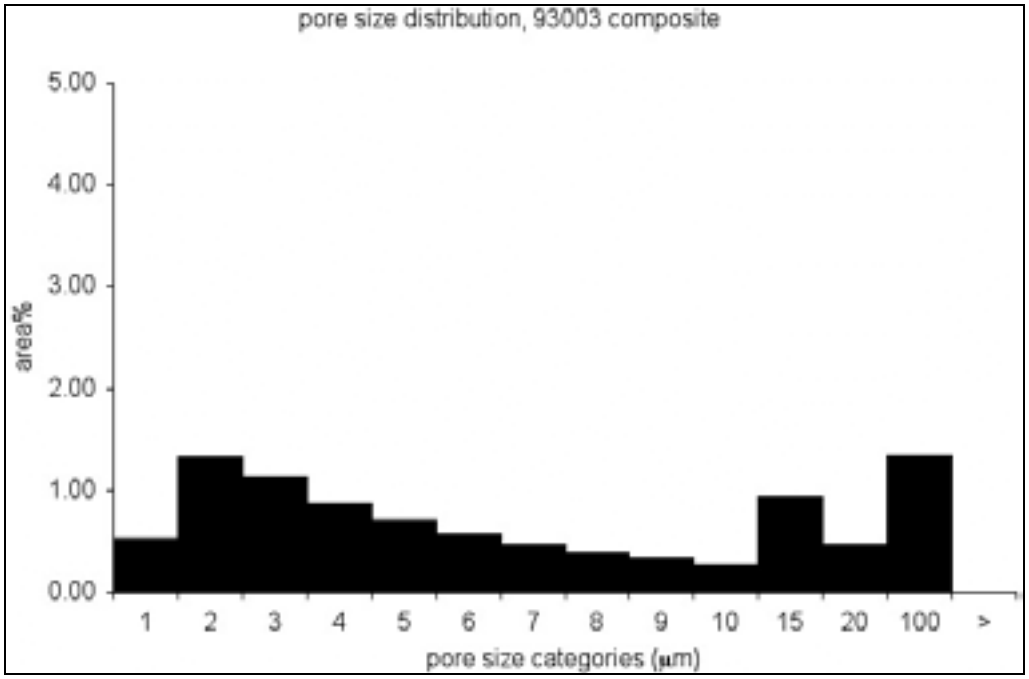


Figure 11-3: Micro-pore size distribution from back-scattered electron images.

Table 11-3: Data for grain intercept length distribution plot shown in Figure 11-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	5.13	5.13
20 to <40	11.80	16.93
40 to <60	12.93	29.86
60 to <80	11.24	41.10
80 to <100	9.79	50.89
100 to <120	7.59	58.48
120 to <140	6.87	65.35
140 to <160	7.08	72.43
160 to <180	5.53	77.95
180 to <200	5.76	83.71
200 to <220	4.50	88.22
220 to <240	2.87	91.08
240 to <280	3.31	94.39
280 to <300	1.00	95.38
300 to <320	0.66	96.04
320 to <340	0.68	96.72
340 to <360	0.71	97.43
360 to <380	0.50	97.93
380 to <400	0.81	98.74
400 to <420	0.00	98.74
420 to <440	0.29	99.03
440 to <460	0.31	99.34
460 to <480	0.66	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 11-4: Data for micro-pore size distribution plot shown in Figure 11-3.

Size categories (μm)	Area %	Cumulative %
0 to <1	0.52	5.59
1 to <2	1.33	19.78
2 to <3	1.13	31.91
3 to <4	0.87	41.25
4 to <5	0.72	48.92
5 to <6	0.57	55.07
6 to <7	0.48	60.15
7 to <8	0.39	64.35
8 to <9	0.33	67.84
9 to <10	0.27	70.74
10 to <15	0.93	80.74
15 to <20	0.46	85.69
20 to <100	1.34	100.00
100 and >	0.00	100.00
sum	9.35	

Table 11-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	18.82
Al_2O_3	0.26
SiO_2	2.97
S	0.12
CaO	31.32
Fe_2O_3	0.39
sum	53.88

Table 11-6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	86.11
Calcite - $CaCO_3$	9.16
Pyrite - FeS_2	0.23
Other	2.97
sum	98.47

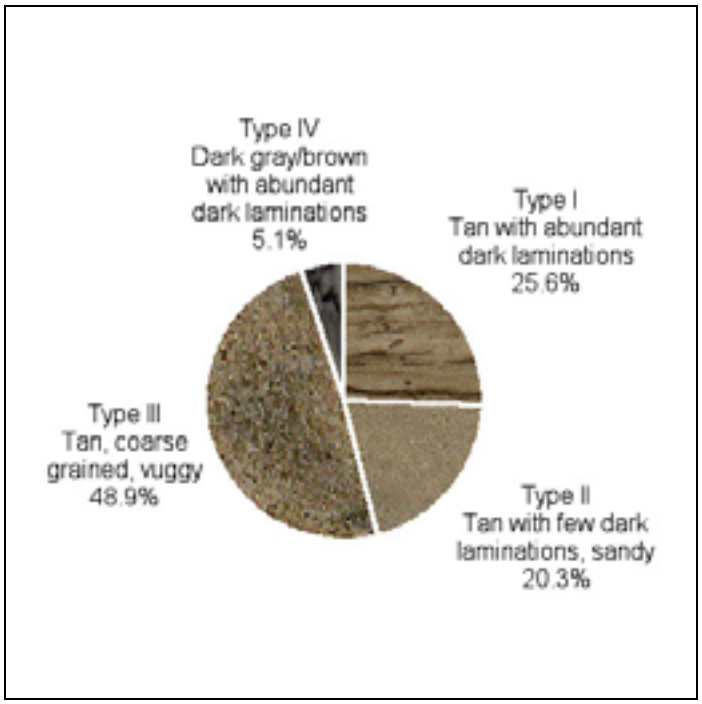


Figure 11-4: Rock types within aggregate source based on differences in color and texture.

Table 11-7: Composition as determined by x-ray fluorescence, by type:

Oxide/element wt%	I	II	III	IV
MgO	19.73	19.65	18.40	19.11
Al_2O_3	0.17	0.75	0.11	0.44
SiO_2	1.56	4.49	0.87	14.09
S	0.08	0.14	0.05	0.07
CaO	31.47	29.11	33.72	24.81
Fe_2O_3	0.27	0.47	0.23	1.26
sum	53.29	54.61	53.38	59.79

Table 11-8: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral wt%	I	II	III	IV
Dolomite - $Ca,Mg(CO_3)_2$	90.29	89.92	84.17	81.58
Calcite - $CaCO_3$	7.17	3.14	14.50	0.00
Pyrite - FeS_2	0.15	0.25	0.09	0.13
Other	1.56	4.49	0.87	14.09
sum	99.17	97.81	99.63	95.80

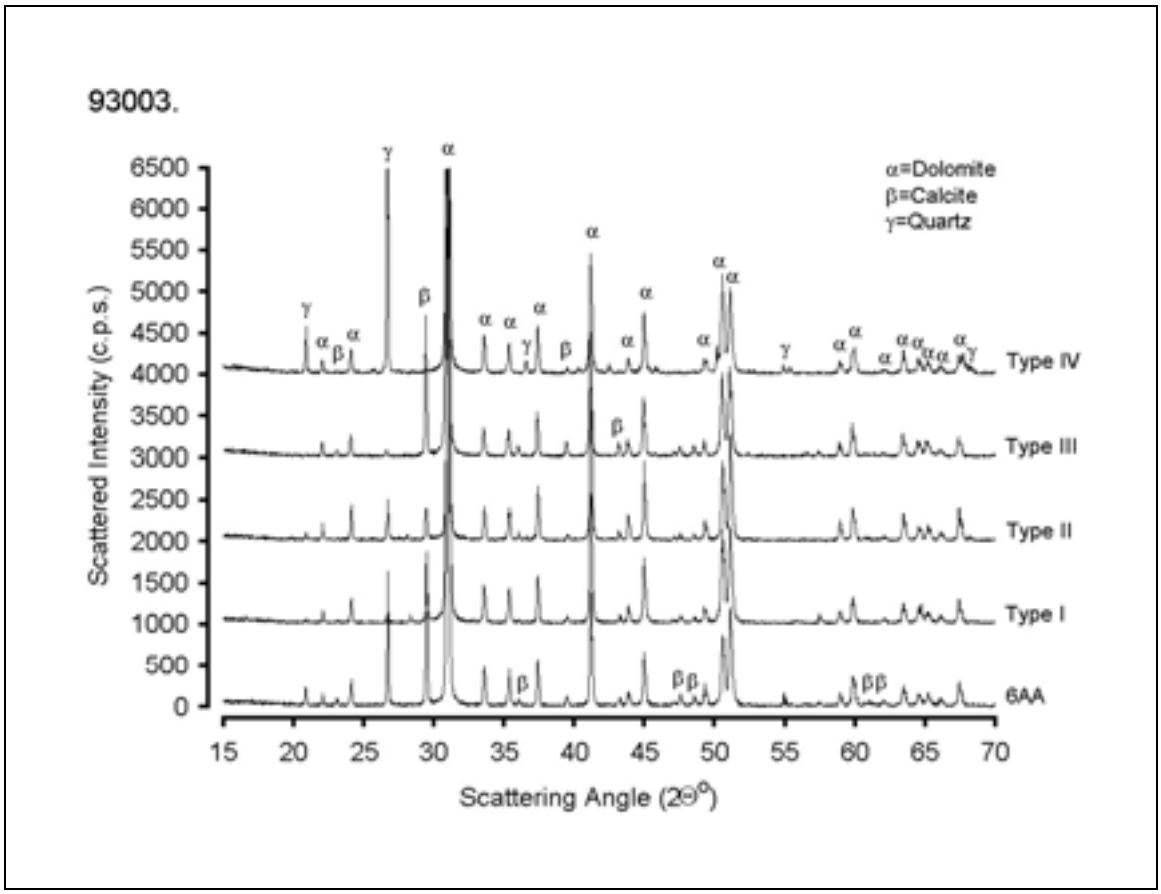


Figure 11-5: X-ray diffraction pattern from aggregate source.

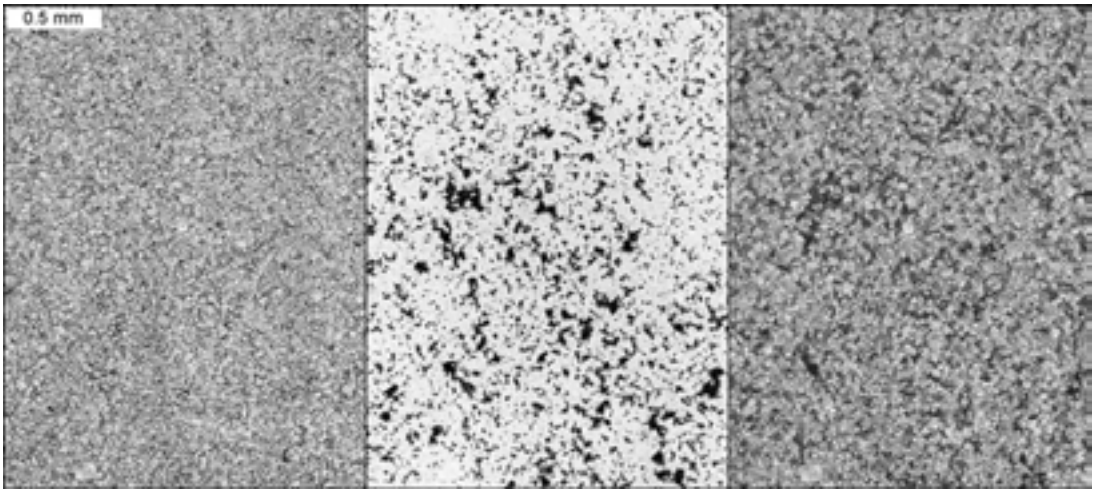


Figure 11-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

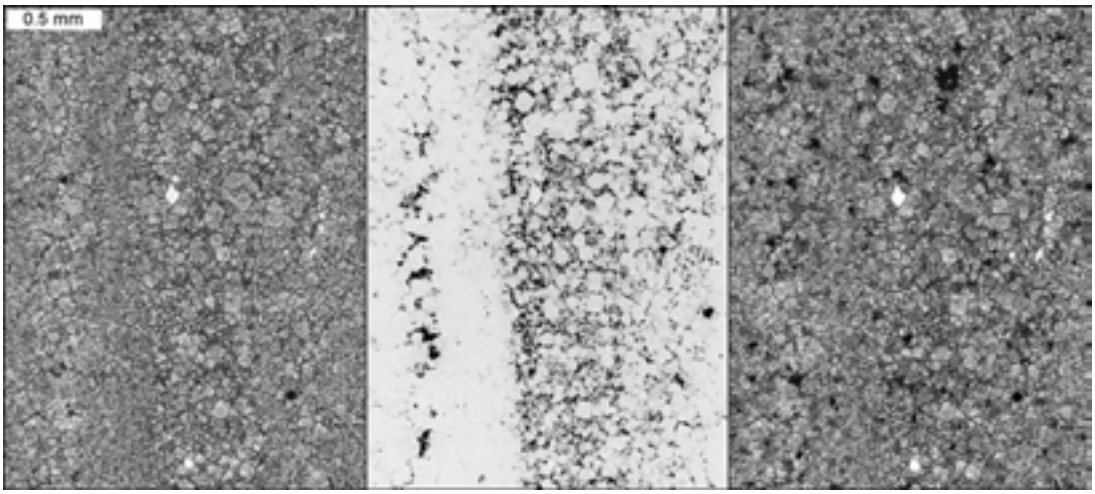


Figure 11-6b: Thin section micrographs for Type II, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

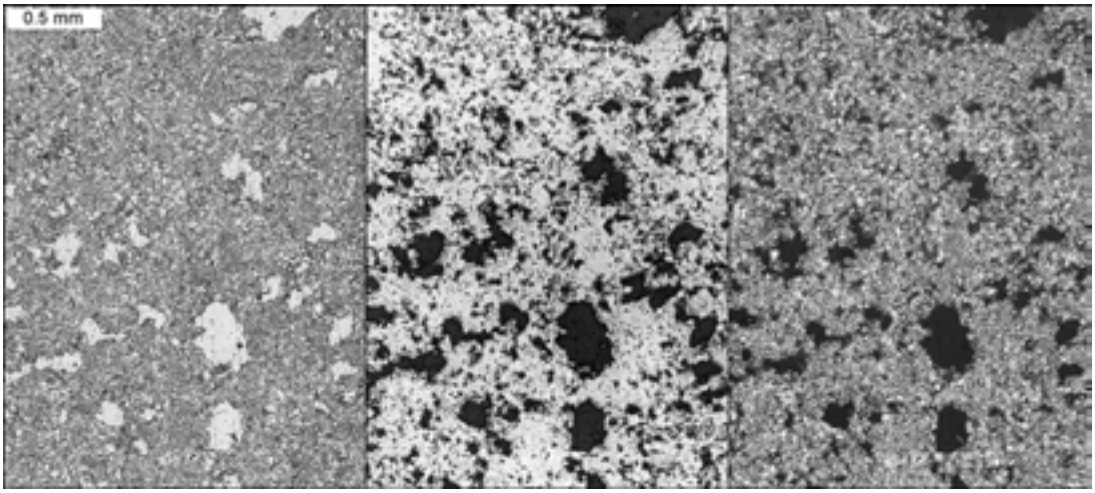


Figure 11-6c: Thin section micrographs for Type III, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

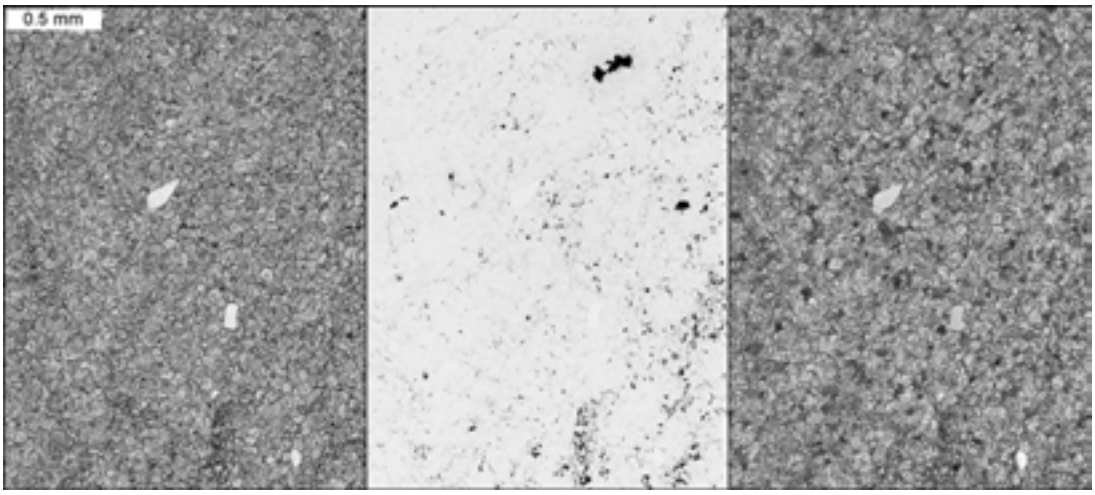


Figure 11-6d: Thin section micrographs for Type IV, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

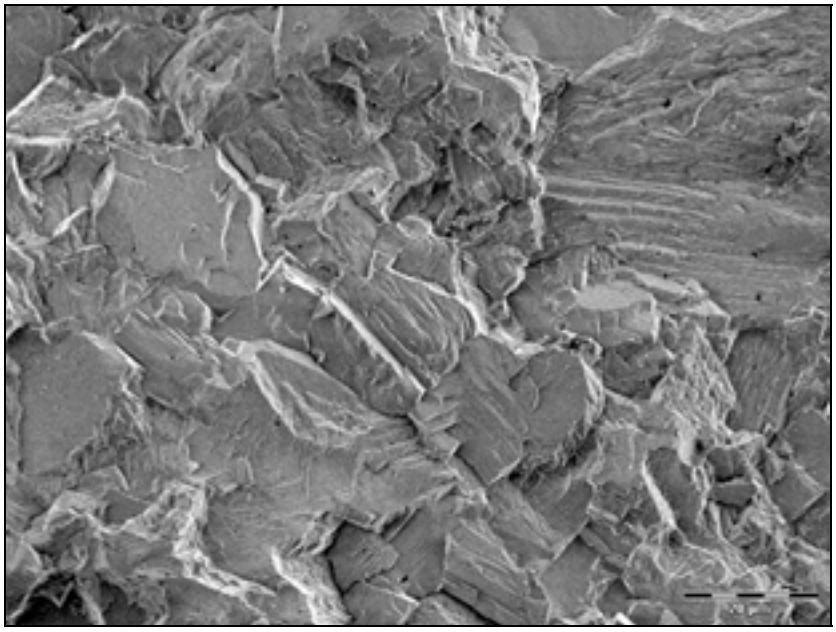


Figure 11-7a: ESEM photo of fracture surface for type I.

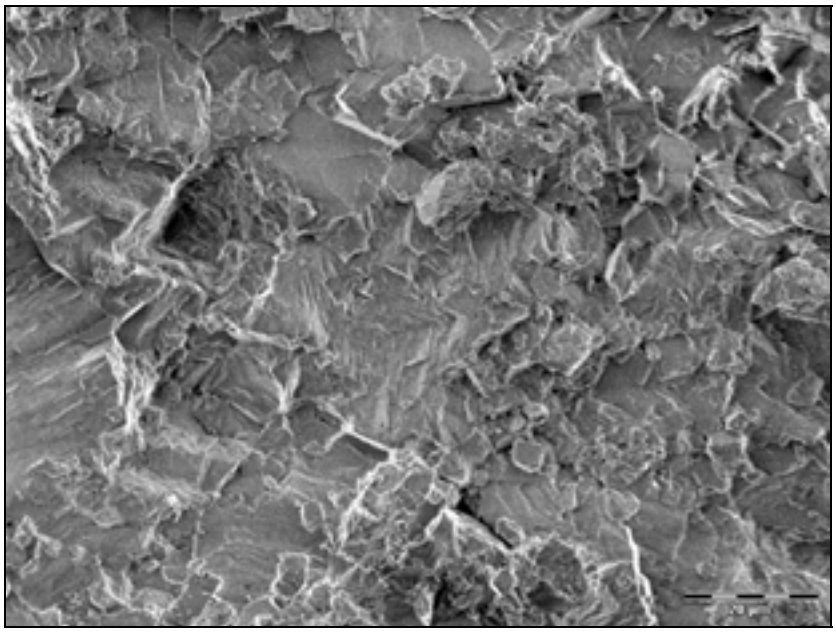


Figure 11-7b: ESEM photo of fracture surface for type II.

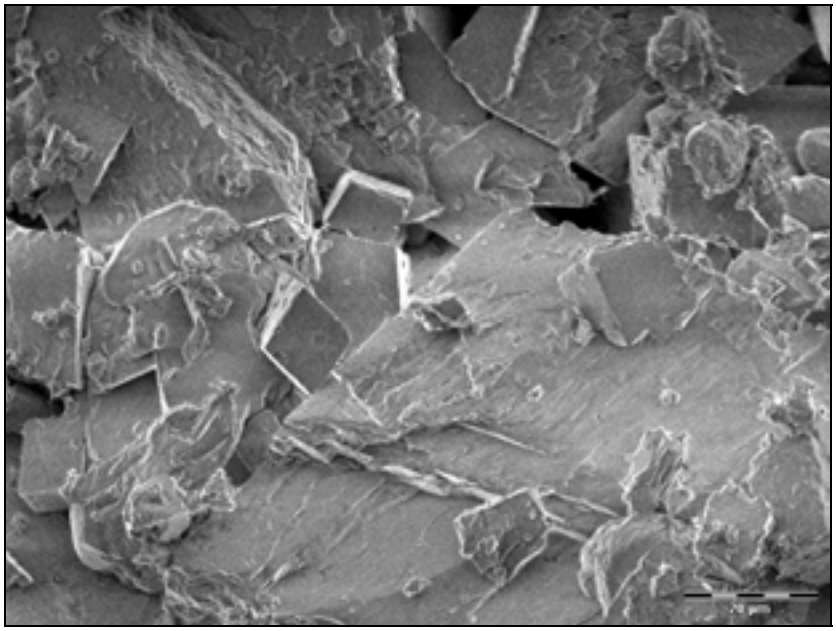


Figure 11-7c: ESEM photo of fracture surface for type III.

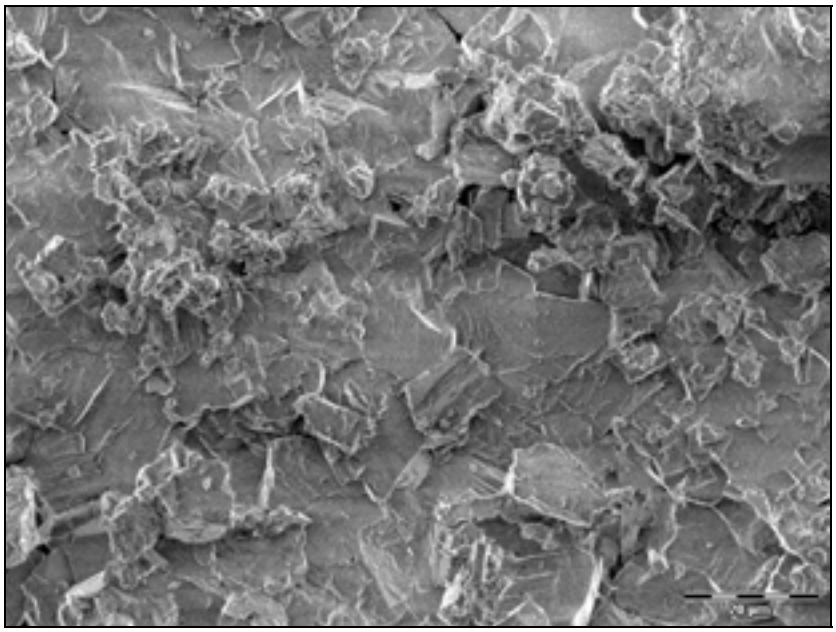


Figure 11-7d: ESEM photo of fracture surface for type IV.

Table 11-9: Grain intercept length statistics, by type:

Grain intercept length (μm)	I	II	III	IV
Average	31.2	66.6	142.4	31.2
Median	24.3	55.7	110.6	26.3
Standard deviation	25.5	45.6	184.7	21.4
Maximum	255.7	236.1	1869.3	130.2
Minimum	2.8	2.8	5.5	2.8

Table 11-10: Micro-pore diameter statistics, by type:

Micro-pore diameter (μm)	I	II	III	IV
Average	1.93	1.95	1.97	1.84
Median	1.13	1.24	1.26	1.27
Standard deviation	2.69	2.09	2.24	1.74
Maximum	49.07	36.14	62.40	44.61
Minimum	0.60	0.60	0.60	0.60

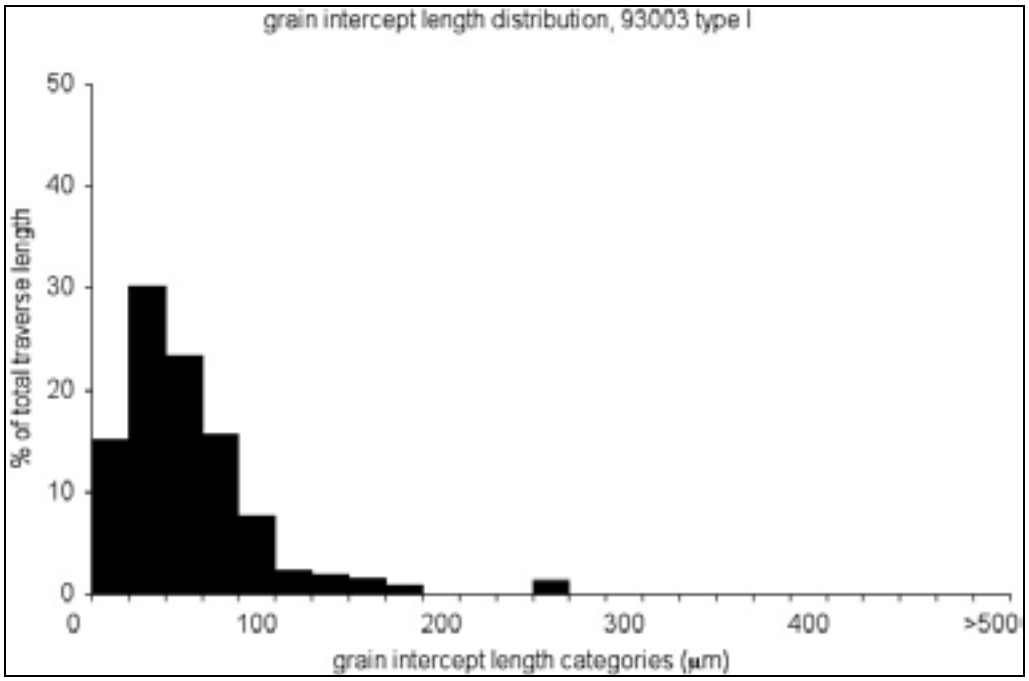


Figure 11-8a: Grain intercept length distribution from petrographic microscope traverse, Type I.

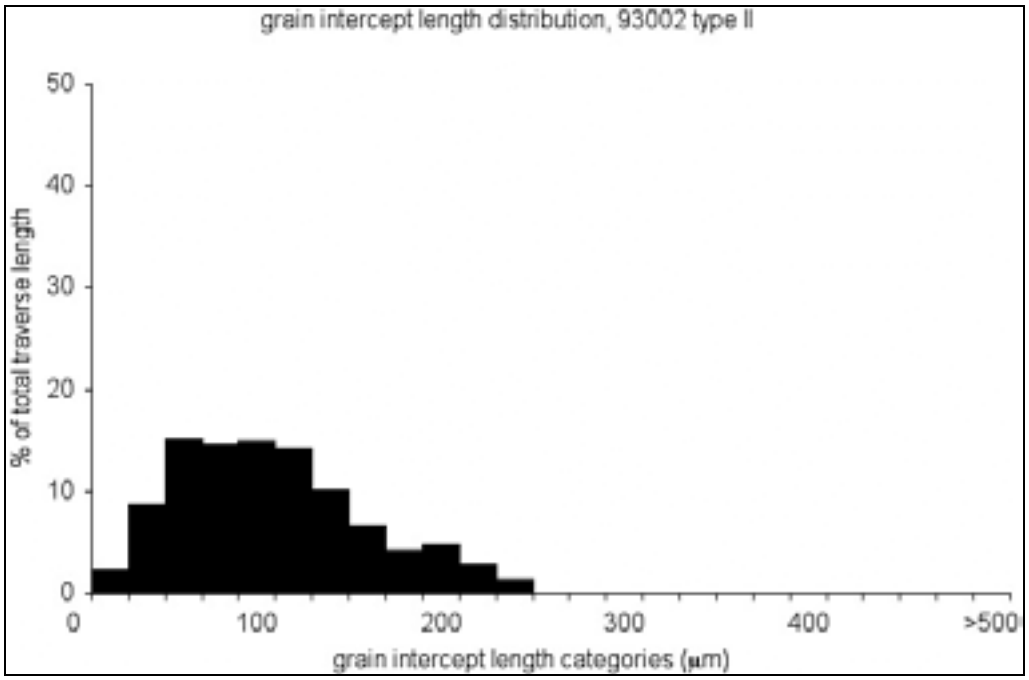


Figure 11-8b: Grain intercept length distribution from petrographic microscope traverse, Type II.

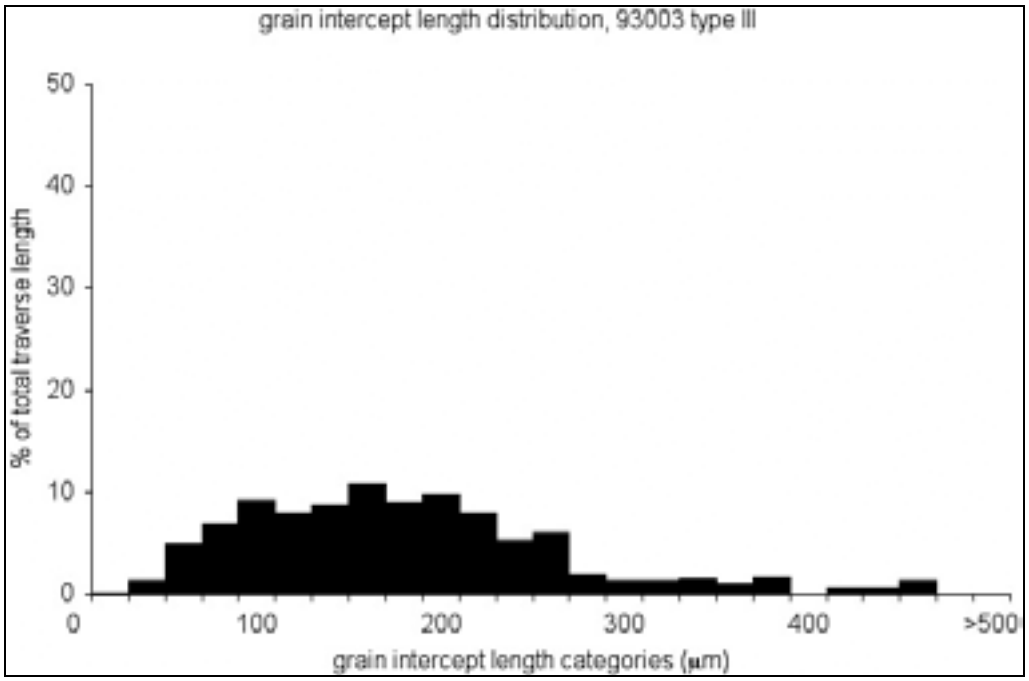


Figure 11-8c: Grain intercept length distribution from petrographic microscope traverse, Type III.

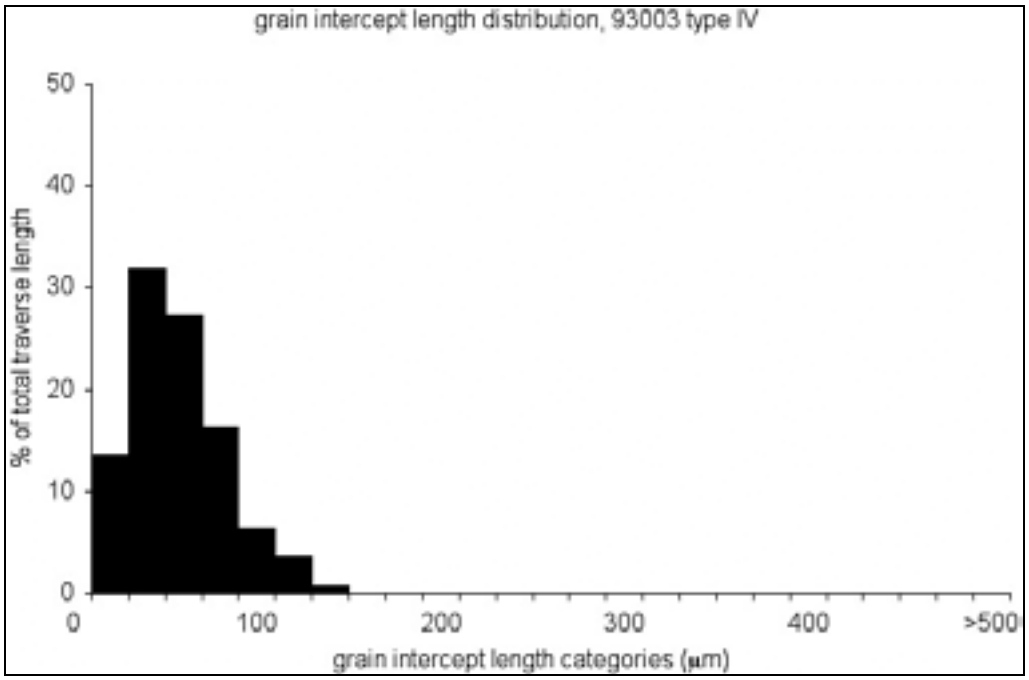


Figure 11-8d: Grain intercept length distribution from petrographic microscope traverse, Type IV.

Table 11-11a: Data for grain intercept length distribution plot shown in Figure 11-8a, (type I):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	15.11	15.11
20 to <40	30.21	45.32
40 to <60	23.47	68.80
60 to <80	15.70	84.50
80 to <100	7.64	92.14
100 to <120	2.24	94.37
120 to <140	1.91	96.28
140 to <160	1.51	97.79
160 to <180	0.90	98.70
180 to <200	0.00	98.70
200 to <220	0.00	98.70
220 to <240	0.00	98.70
240 to <280	1.30	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 11-11b: Data for grain intercept length distribution plot shown in Figure 11-8b, (type II):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	2.32	2.32
20 to <40	8.72	11.04
40 to <60	15.17	26.21
60 to <80	14.70	40.91
80 to <100	14.90	55.81
100 to <120	14.16	69.97
120 to <140	10.10	80.07
140 to <160	6.70	86.77
160 to <180	4.21	90.98
180 to <200	4.80	95.78
200 to <220	2.92	98.70
220 to <240	1.30	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 11-11c: Data for grain intercept length distribution plot shown in Figure 11-8c, (type III):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	0.17	0.17
20 to <40	1.35	1.52
40 to <60	4.98	6.50
60 to <80	6.93	13.43
80 to <100	9.15	22.58
100 to <120	8.08	30.66
120 to <140	8.76	39.42
140 to <160	10.89	50.31
160 to <180	9.07	59.38
180 to <200	9.78	69.16
200 to <220	7.98	77.14
220 to <240	5.32	82.46
240 to <280	6.07	88.53
280 to <300	2.04	90.57
300 to <320	1.34	91.91
320 to <340	1.38	93.29
340 to <360	1.45	94.74
360 to <380	1.03	95.78
380 to <400	1.65	97.43
400 to <420	0.00	97.43
420 to <440	0.60	98.02
440 to <460	0.64	98.66
460 to <480	1.34	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

Table 11-11d: Data for grain intercept length distribution plot shown in Figure 11-8d, (type IV):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	13.63	13.63
20 to <40	31.85	45.49
40 to <60	27.37	72.85
60 to <80	16.38	89.24
80 to <100	6.42	95.66
100 to <120	3.60	99.26
120 to <140	0.74	100.00
140 to <160	0.00	100.00
160 to <180	0.00	100.00
180 to <200	0.00	100.00
200 to <220	0.00	100.00
220 to <240	0.00	100.00
240 to <280	0.00	100.00
280 to <300	0.00	100.00
300 to <320	0.00	100.00
320 to <340	0.00	100.00
340 to <360	0.00	100.00
360 to <380	0.00	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

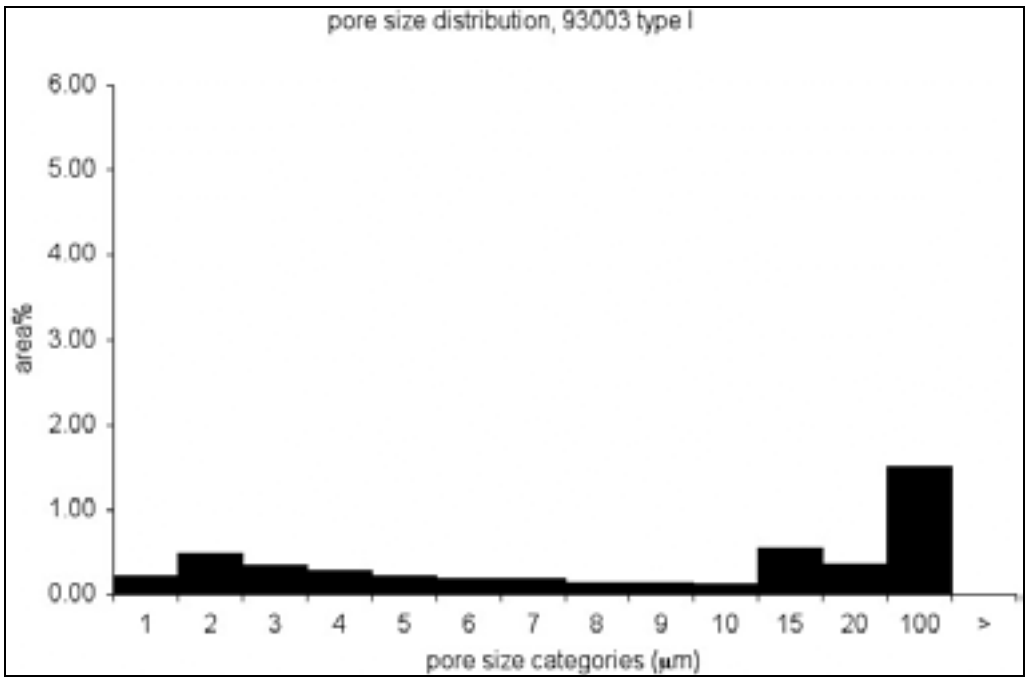


Figure 11-9a: Micro-pore size distribution from back-scattered electron images, type I.

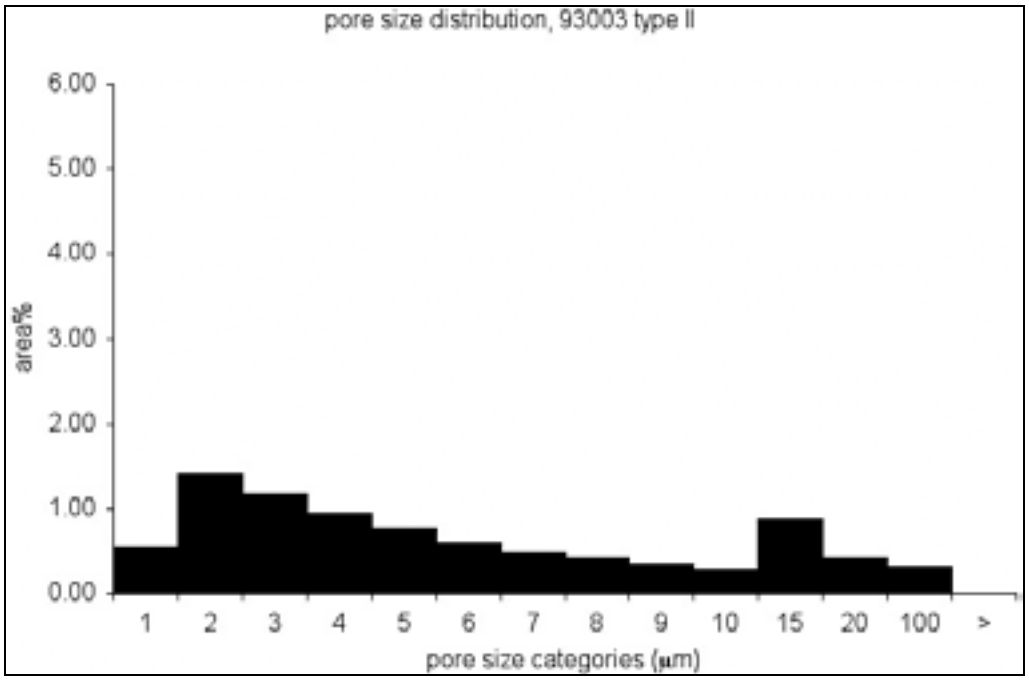


Figure 11-9b: Micro-pore size distribution from back-scattered electron images, type II.

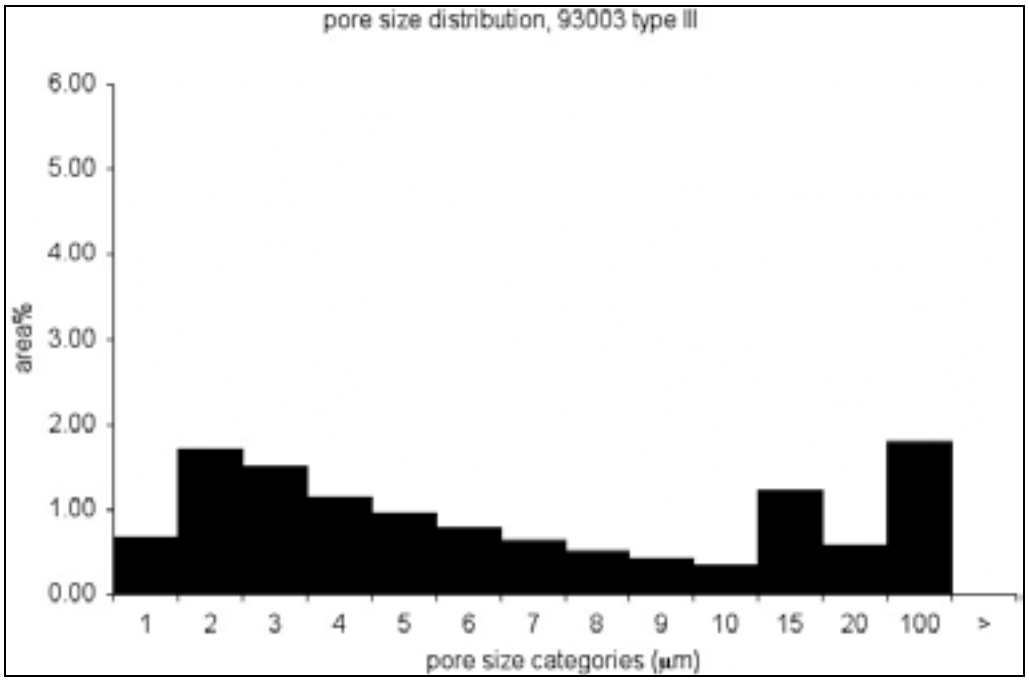


Figure 11-9c: Micro-pore size distribution from back-scattered electron images, type III.

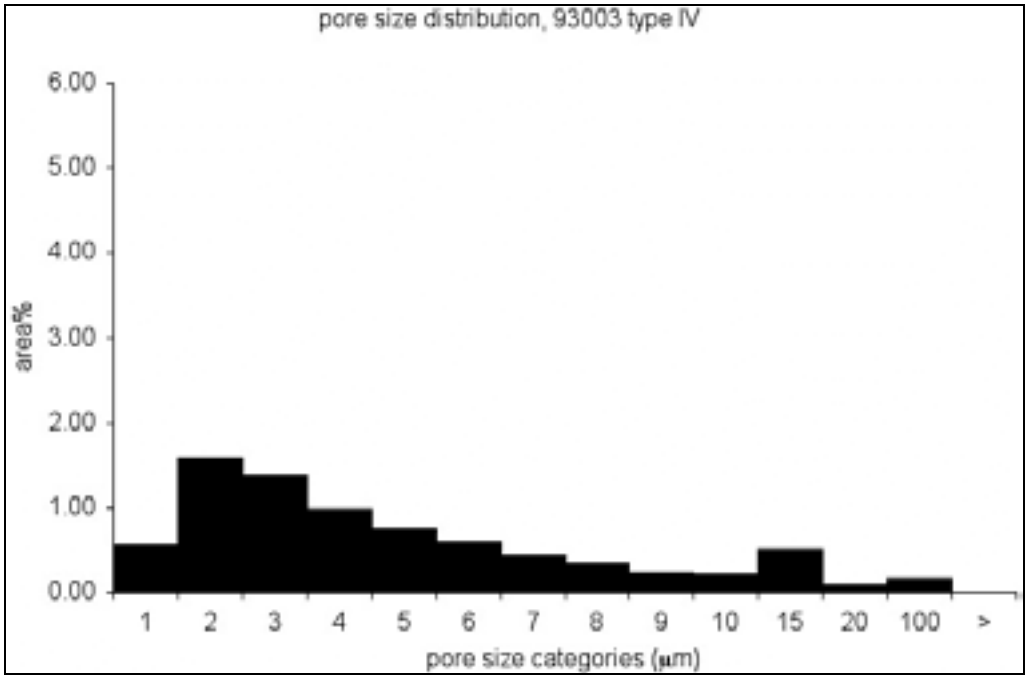


Figure 11-9d: Micro-pore size distribution from back-scattered electron images, type IV.

Table 11-12a: Data for micro-pore size distribution plot shown in Figure 11-9a, (type I).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.22	4.68
1 to <2	0.49	15.16
2 to <3	0.34	22.40
3 to <4	0.27	28.10
4 to <5	0.21	32.67
5 to <6	0.17	36.39
6 to <7	0.17	40.09
7 to <8	0.15	43.26
8 to <9	0.15	46.43
9 to <10	0.12	49.04
10 to <15	0.54	60.45
15 to <20	0.36	68.03
20 to <100	1.50	100.00
100 and >	0.00	100.00
sum	4.69	

Table 11-12b: Data for micro-pore size distribution plot shown in Figure 11-9b, (type II).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.55	6.44
1 to <2	1.41	22.87
2 to <3	1.17	36.53
3 to <4	0.95	47.61
4 to <5	0.76	56.50
5 to <6	0.60	63.49
6 to <7	0.48	69.11
7 to <8	0.42	74.01
8 to <9	0.35	78.11
9 to <10	0.28	81.35
10 to <15	0.87	91.48
15 to <20	0.42	96.43
20 to <100	0.31	100.00
100 and >	0.00	100.00
sum	8.58	

Table 11-12c: Data for micro-pore size distribution plot shown in Figure 11-9c, (type III).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.66	5.42
1 to <2	1.70	19.30
2 to <3	1.51	31.61
3 to <4	1.15	40.97
4 to <5	0.96	48.78
5 to <6	0.77	55.07
6 to <7	0.64	60.25
7 to <8	0.51	64.44
8 to <9	0.42	67.85
9 to <10	0.35	70.72
10 to <15	1.21	80.62
15 to <20	0.57	85.30
20 to <100	1.80	100.00
100 and >	0.00	100.00
sum	12.26	

Table 11-12d: Data for micro-pore size distribution plot shown in Figure 11-9d, (type IV).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.57	7.26
1 to <2	1.58	27.43
2 to <3	1.37	44.92
3 to <4	0.98	57.39
4 to <5	0.74	66.78
5 to <6	0.60	74.48
6 to <7	0.43	79.97
7 to <8	0.35	84.46
8 to <9	0.23	87.36
9 to <10	0.22	90.17
10 to <15	0.51	96.70
15 to <20	0.10	97.94
20 to <100	0.16	100.00
100 and >	0.00	100.00
sum	7.84	

Table 11-13: Coefficient of thermal expansion, by type:

Type	Coefficient of thermal expansion (mm/mm/degree C):
I	7.69E-06
II	8.03E-06
III	7.81E-06
IV	7.56E-06

95005 - Manitoulin, Canada

Table 12-1: Pit name, location, and general geologic information:

Pit Number	95005
Name	Manitoulin, Canada
Longitude	-83.12
Latitude	45.93
Era	Palaeozoic
Period	Silurian
Group	
Member	Amabel
Rock Type	dolomite
Description	Light tan to gray to dark gray medium to coarse grained dolomite.

Table 12-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	8.183E-06
Bulk specific gravity (oven dry)	2.80
Bulk specific gravity (saturated surface dry)	2.81
Apparent specific gravity	2.84
Absorption %	0.43
Average grain intercept length (µm)	123.4
Area % micro-pores	4.57
Average micro-pore diameter (µm)	1.62

Figure 12-1: Photo of 3/8" sieve fraction of 6AA product.

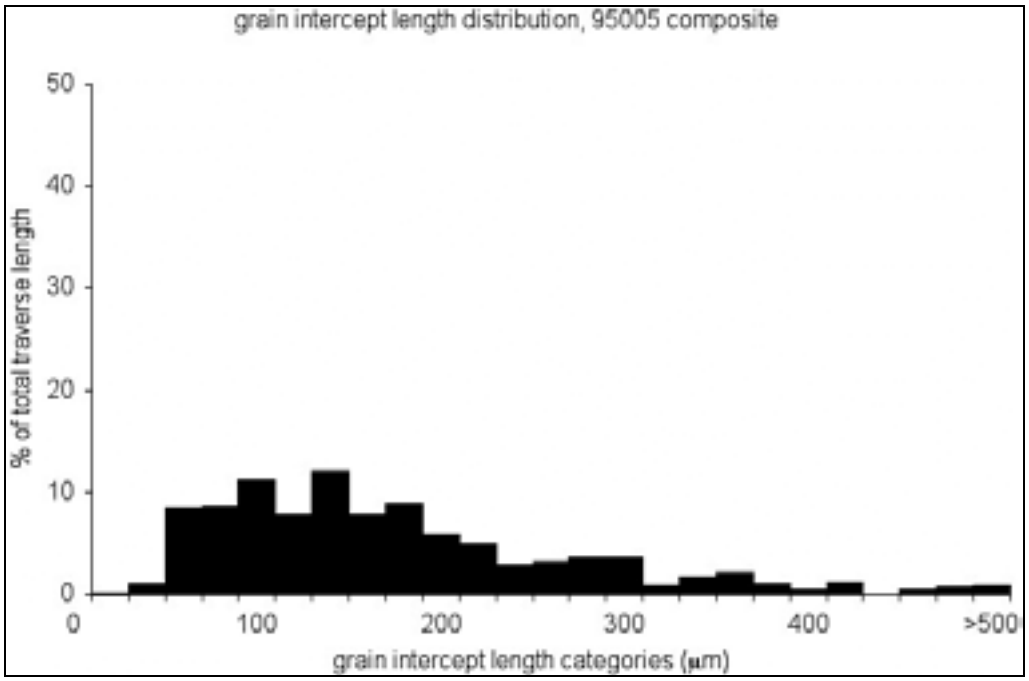


Figure 12-2: Grain intercept length distribution from petrographic microscope traverse.

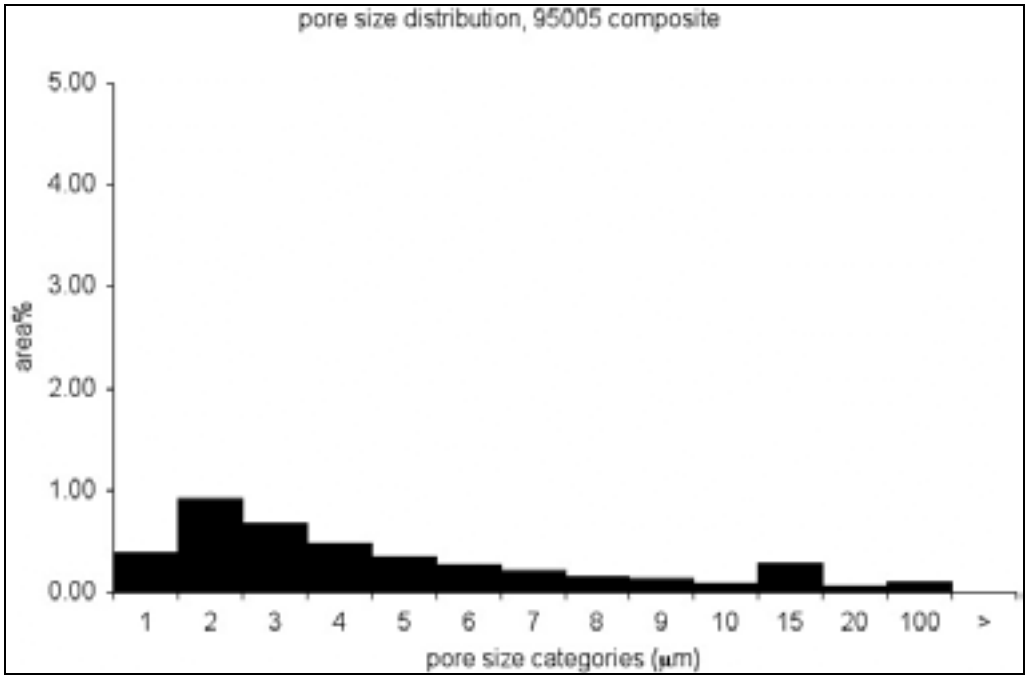


Figure 12-3: Micro-pore size distribution from back-scattered electron images.

Table 12-3: Data for grain intercept length distribution plot shown in Figure 12-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	0.11	0.11
20 to <40	1.10	1.21
40 to <60	8.53	9.73
60 to <80	8.62	18.35
80 to <100	11.17	29.52
100 to <120	7.83	37.35
120 to <140	12.11	49.47
140 to <160	7.91	57.38
160 to <180	8.86	66.24
180 to <200	5.89	72.13
200 to <220	4.97	77.10
220 to <240	2.90	80.00
240 to <280	3.13	83.13
280 to <300	3.62	86.75
300 to <320	3.69	90.44
320 to <340	0.90	91.34
340 to <360	1.60	92.94
360 to <380	2.18	95.12
380 to <400	1.06	96.19
400 to <420	0.45	96.63
420 to <440	1.18	97.81
440 to <460	0.00	97.81
460 to <480	0.53	98.34
480 to <500	0.81	99.15
500 and >	0.85	100.00

Table 12-4: Data for micro-pore size distribution plot shown in Figure 12-3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.40	9.58
1 to <2	0.92	31.63
2 to <3	0.69	48.15
3 to <4	0.48	59.62
4 to <5	0.35	68.03
5 to <6	0.27	74.64
6 to <7	0.21	79.76
7 to <8	0.15	83.43
8 to <9	0.13	86.63
9 to <10	0.09	88.86
10 to <15	0.28	95.69
15 to <20	0.07	97.28
20 to <100	0.11	100.00
100 and >	0.00	100.00
sum	4.16	

Table 12-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	21.41
Al_2O_3	0.26
SiO_2	1.34
S	0.04
CaO	29.79
Fe_2O_3	0.22
sum	53.06

Table 12-6: Mineral wt% values computed from x-ray fluorescence:

Mineral	wt%
Dolomite - $Ca,Mg(CO_3)_2$	97.93
Calcite - $CaCO_3$	0.01
Pyrite - FeS_2	0.08
Other	1.34
sum	99.36

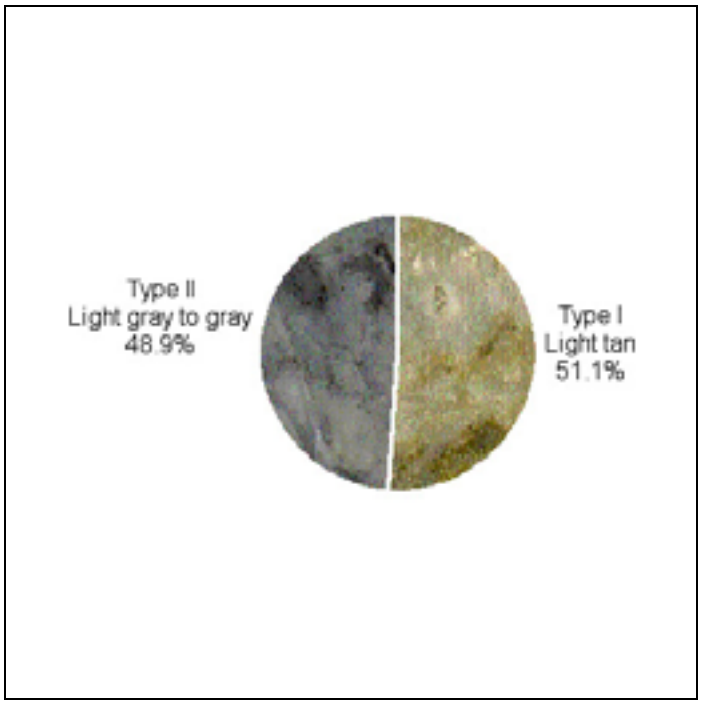


Figure 12-4: Rock types within aggregate source based on differences in color and texture.

Table 12-7: Composition as determined by x-ray fluorescence, by type:

Oxide/element wt%	I	II
MgO	21.51	21.37
Al_2O_3	0.12	0.37
SiO_2	0.50	1.70
S	0.01	0.05
CaO	30.27	29.57
Fe_2O_3	0.26	0.36
sum	52.68	53.43

Table 12-8: Mineral wt% values computed from x-ray fluorescence, by type:

Mineral wt%	I	II
Dolomite - $Ca,Mg(CO_3)_2$	98.43	97.24
Calcite - $CaCO_3$	0.59	0.00
Pyrite - FeS_2	0.02	0.09
Other	0.50	1.70
sum	99.54	99.03

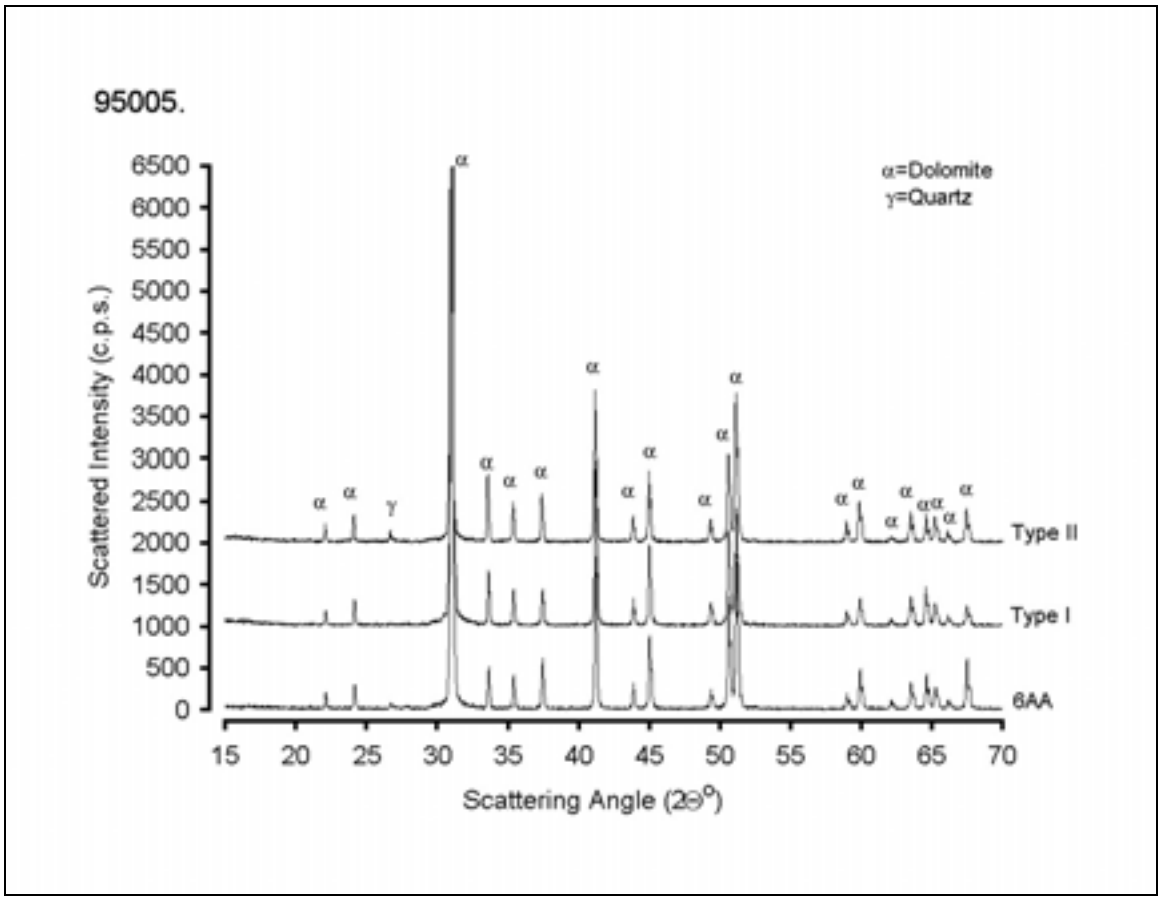


Figure 12-5: X-ray diffraction pattern from aggregate source.

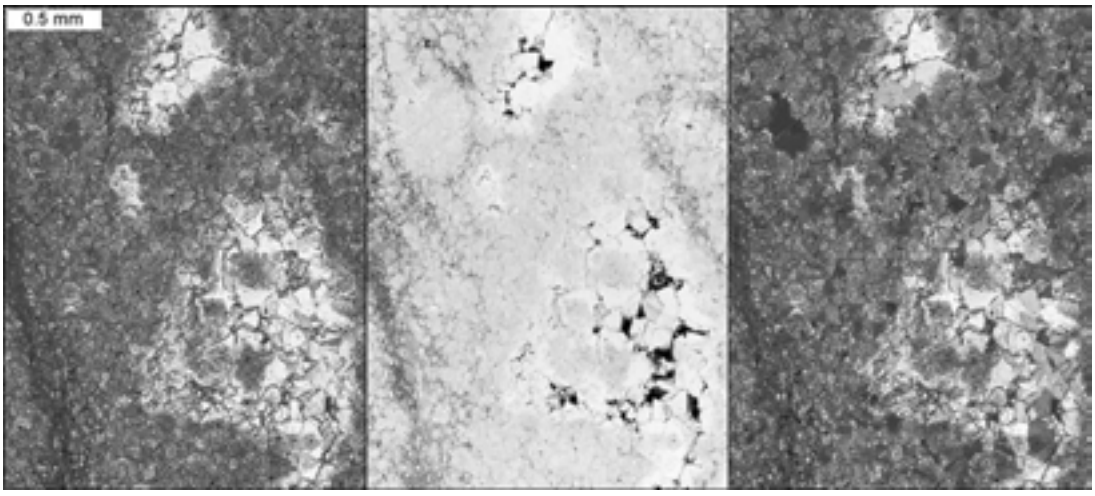


Figure 12-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

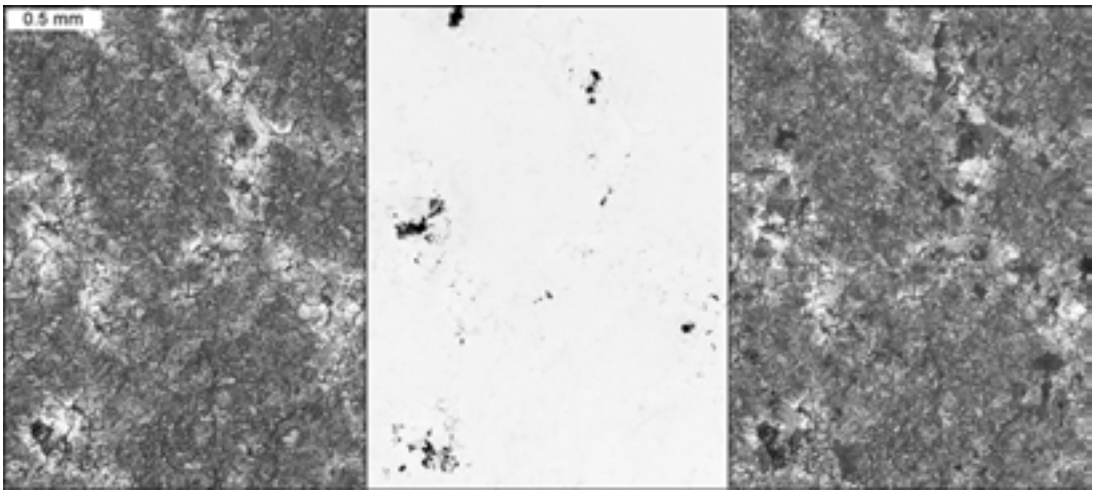


Figure 12-6b: Thin section micrographs for Type II, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

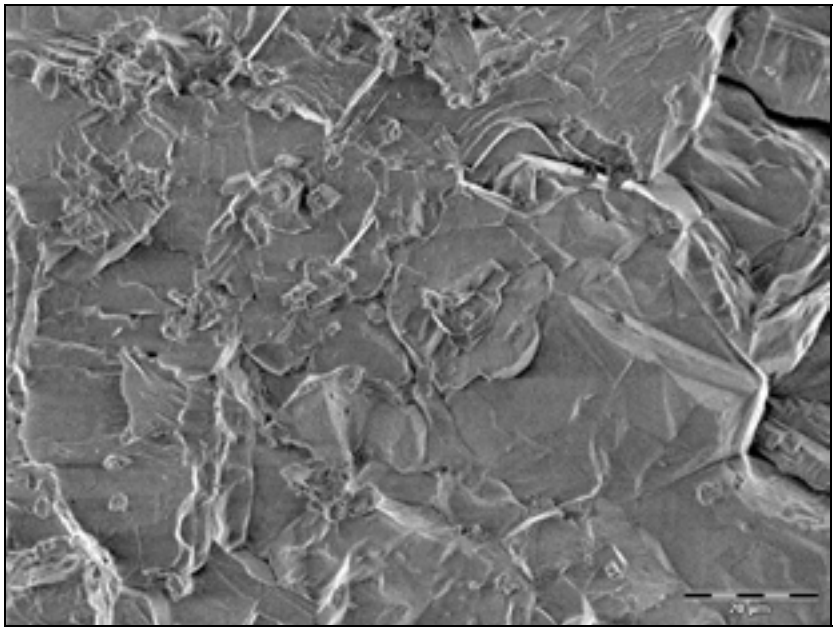


Figure 12-7a: ESEM photo of fracture surface for type I.

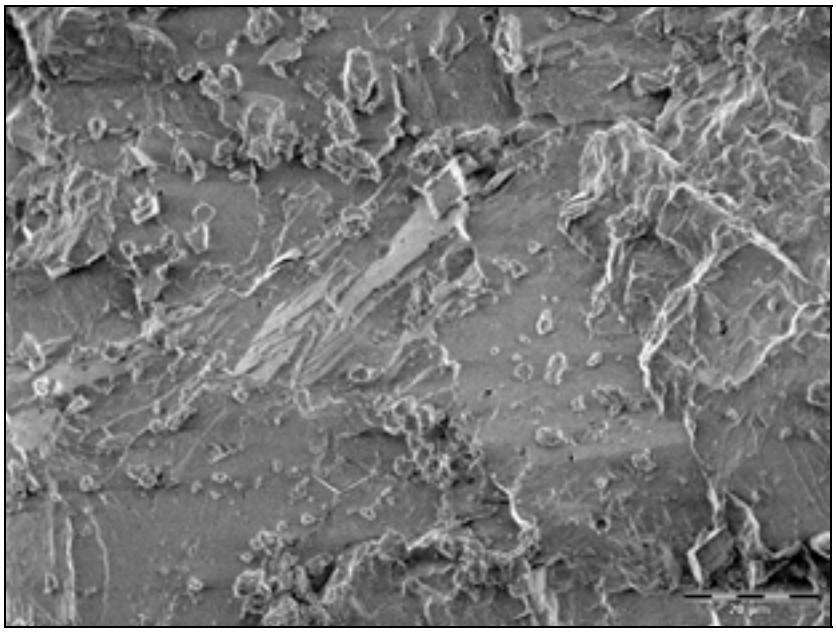


Figure 12-7b: ESEM photo of fracture surface for type II.

Table 12-9: Grain intercept length statistics, by type:

Grain intercept length (μm)	I	II
Average	145.8	99.8
Median	122.3	82.7
Standard deviation	100.0	55.9
Maximum	654.1	550.9
Minimum	11.2	11.2

Table 12-10: Micro-pore diameter statistics, by type:

Micro-pore diameter (μm)	I	II
Average	1.66	1.58
Median	1.13	1.06
Standard deviation	1.70	1.58
Maximum	43.30	35.44
Minimum	0.60	0.60

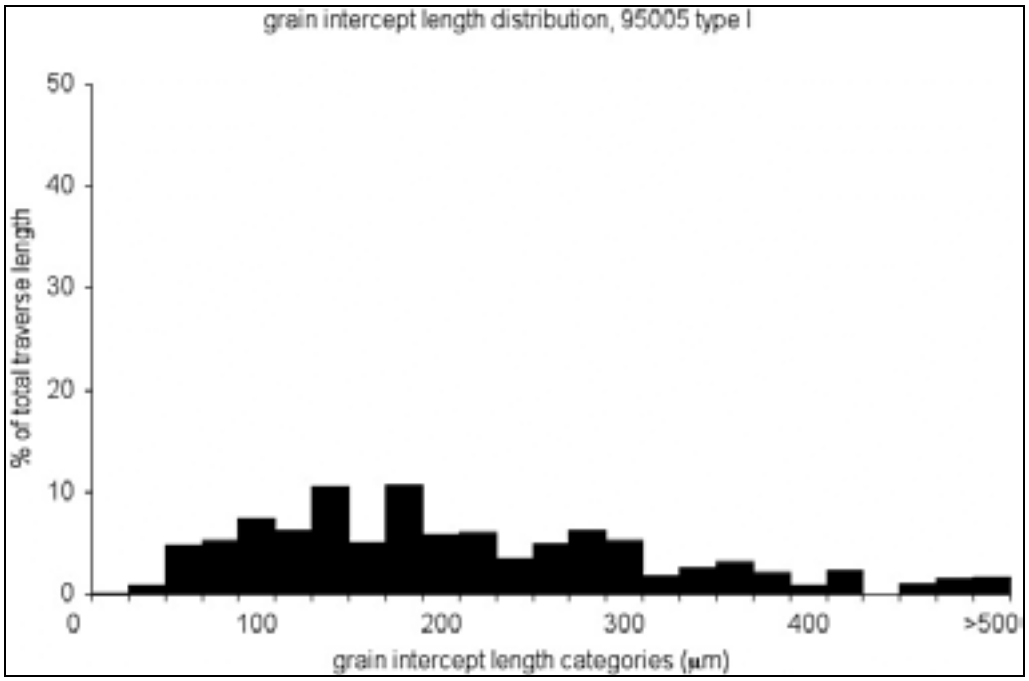


Figure 12-8a: Grain intercept length distribution from petrographic microscope traverse, Type I.

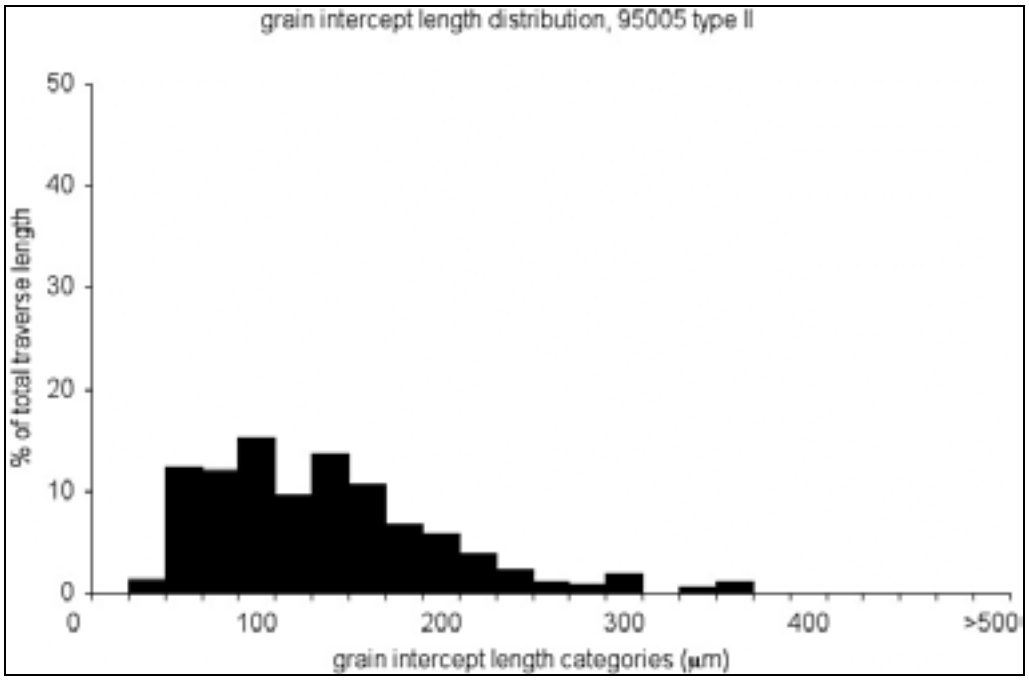


Figure 12-8b: Grain intercept length distribution from petrographic microscope traverse, Type II.

Table 12-11a: Data for grain intercept length distribution plot shown in Figure 12-8a, (type I):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	0.17	0.17
20 to <40	0.86	1.03
40 to <60	4.89	5.92
60 to <80	5.26	11.18
80 to <100	7.33	18.51
100 to <120	6.13	24.64
120 to <140	10.54	35.18
140 to <160	5.20	40.38
160 to <180	10.78	51.15
180 to <200	5.91	57.06
200 to <220	6.00	63.06
220 to <240	3.44	66.50
240 to <280	4.92	71.42
280 to <300	6.19	77.61
300 to <320	5.35	82.96
320 to <340	1.76	84.72
340 to <360	2.59	87.31
360 to <380	3.16	90.46
380 to <400	2.08	92.54
400 to <420	0.88	93.42
420 to <440	2.31	95.72
440 to <460	0.00	95.72
460 to <480	1.03	96.76
480 to <500	1.58	98.33
500 and >	1.67	100.00

Table 12-11b: Data for grain intercept length distribution plot shown in Figure 12-8b, (type II):

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	0.04	0.04
20 to <40	1.35	1.39
40 to <60	12.34	13.73
60 to <80	12.14	25.86
80 to <100	15.19	41.05
100 to <120	9.61	50.66
120 to <140	13.76	64.42
140 to <160	10.75	75.17
160 to <180	6.86	82.04
180 to <200	5.87	87.90
200 to <220	3.91	91.81
220 to <240	2.33	94.14
240 to <280	1.25	95.39
280 to <300	0.93	96.32
300 to <320	1.96	98.28
320 to <340	0.00	98.28
340 to <360	0.56	98.84
360 to <380	1.16	100.00
380 to <400	0.00	100.00
400 to <420	0.00	100.00
420 to <440	0.00	100.00
440 to <460	0.00	100.00
460 to <480	0.00	100.00
480 to <500	0.00	100.00
500 and >	0.00	100.00

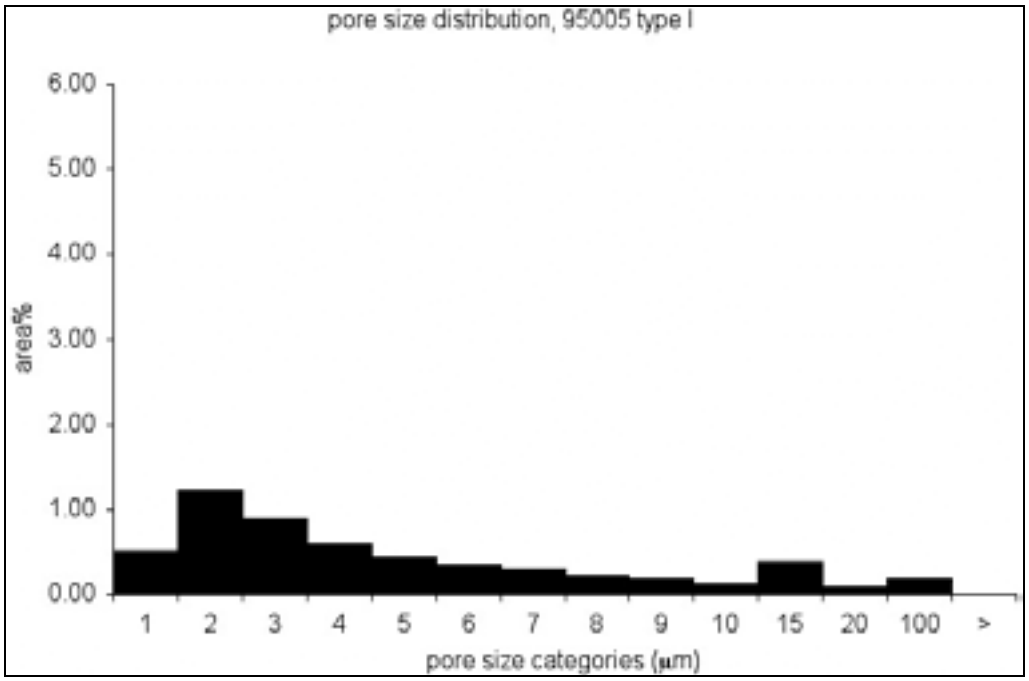


Figure 12-9a: Micro-pore size distribution from back-scattered electron images, type I.

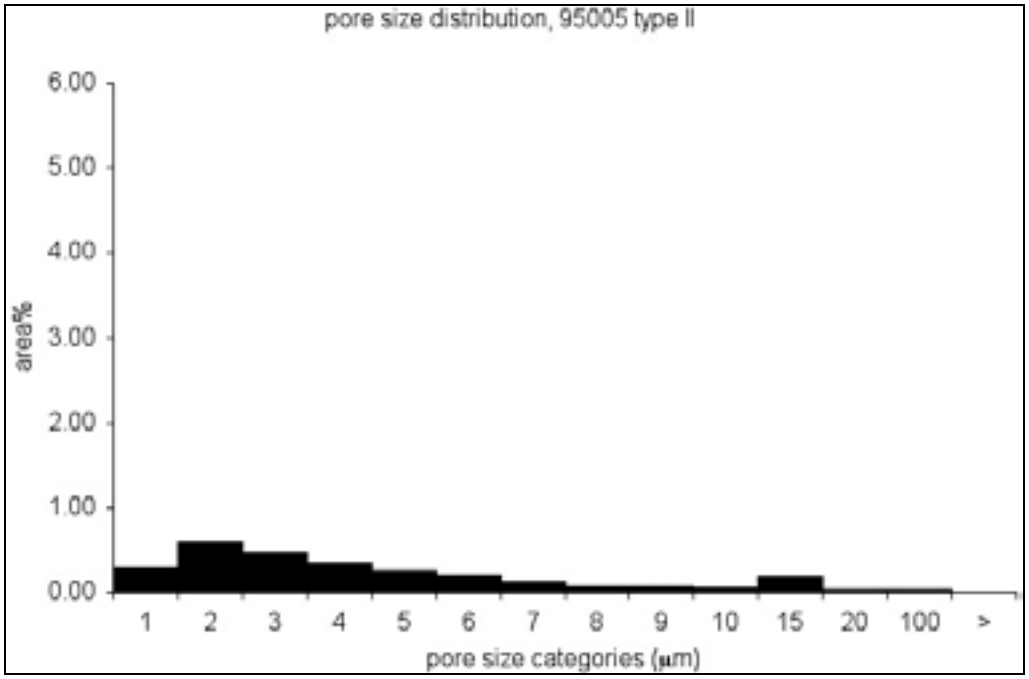


Figure 12-9b: Micro-pore size distribution from back-scattered electron images, type II.

Table 12-12a: Data for micro-pore size distribution plot shown in Figure 12-9a, (type I).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.50	9.13
1 to <2	1.22	31.28
2 to <3	0.89	47.51
3 to <4	0.60	58.50
4 to <5	0.44	66.54
5 to <6	0.35	72.91
6 to <7	0.29	78.23
7 to <8	0.22	82.27
8 to <9	0.19	85.66
9 to <10	0.13	88.00
10 to <15	0.38	94.90
15 to <20	0.10	96.68
20 to <100	0.18	100.00
100 and >	0.00	100.00
sum	5.50	

Table 12-12b: Data for micro-pore size distribution plot shown in Figure 12-9b, (type II).

Size categories (μm)	Area %	Cumulative %
0 to <1	0.29	10.52
1 to <2	0.60	32.37
2 to <3	0.47	49.49
3 to <4	0.34	61.94
4 to <5	0.25	71.13
5 to <6	0.20	78.25
6 to <7	0.13	82.96
7 to <8	0.08	85.84
8 to <9	0.08	88.66
9 to <10	0.05	90.65
10 to <15	0.18	97.34
15 to <20	0.03	98.54
20 to <100	0.04	100.00
100 and >	0.00	100.00
sum	2.76	

Table 12-13: Coefficient of thermal expansion, by type:

Type	Coefficient of thermal expansion (mm/mm/degree C):
I	7.85E-06
II	8.52E-06

95010 - Bruce Mines

Table 13-1: Pit name, location, and general geologic information:

Pit Number	95010
Name	Bruce Mines, Canada
Longitude	-83.79
Latitude	46.31
Era	Proterozoic
Period	
Group	Nipissing Diabase
Member	
Rock Type	gabbro
Description	Gabbro, major phases: plagioclase, hornblende, minor phases: magnetite, quartz, apatite

Table 13-2: General physical properties:

Coefficient of thermal expansion (mm/mm/degree C)	6.594E-06
Bulk specific gravity (oven dry)	2.91
Bulk specific gravity (saturated surface dry)	2.92
Apparent specific gravity	2.94
Absorption %	0.36
Average grain intercept length (µm)	149.2
Area % micro-pores	3.22
Average micro-pore diameter (µm)	1.44

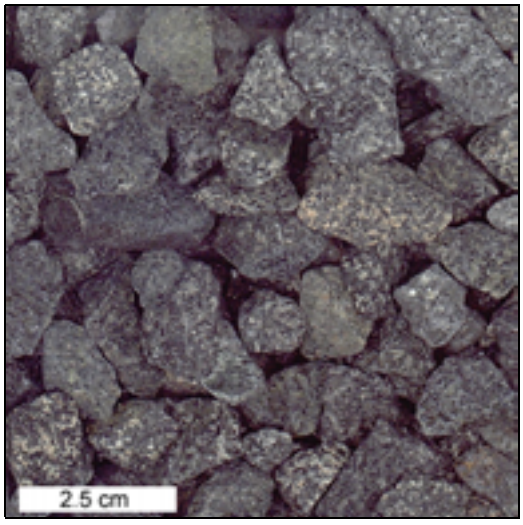


Figure 13-1: Photo of 3/8" sieve fraction of 6AA product.

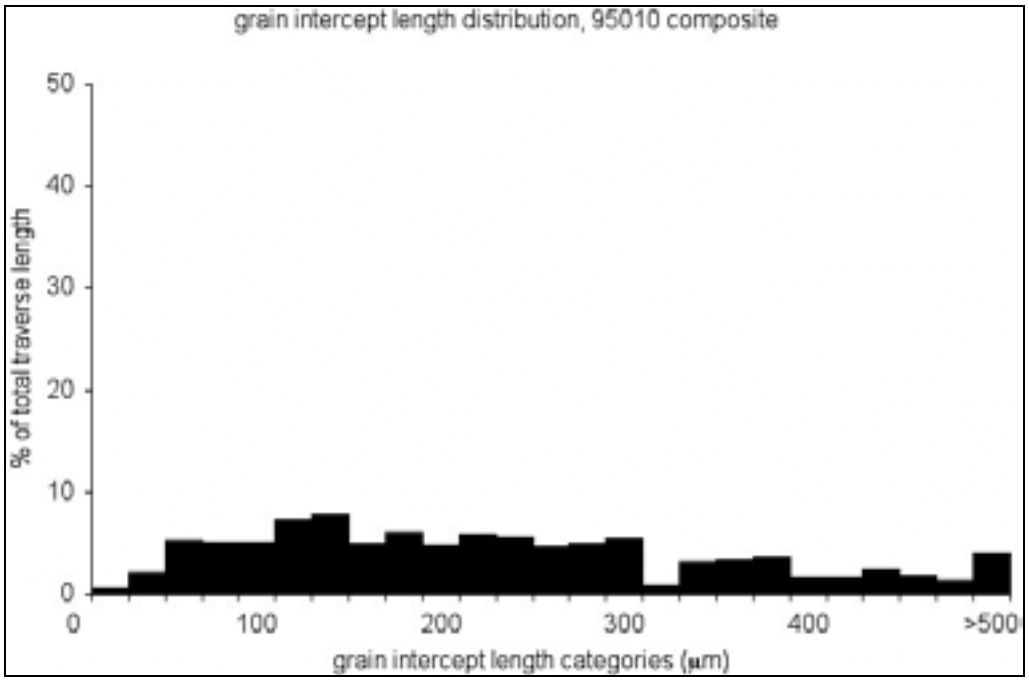


Figure 13-2: Grain intercept length distribution from petrographic microscope traverse.

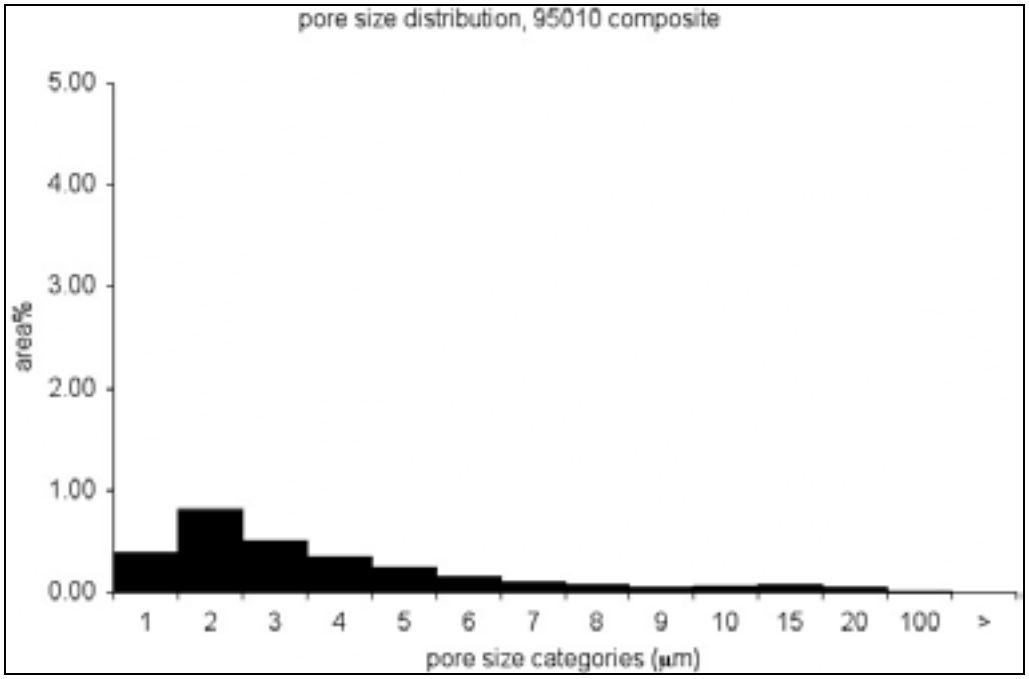


Figure 13-3: Micro-pore size distribution from back-scattered electron images.

Table 13-3: Data for grain intercept length distribution plot shown in Figure 13-2.

Size categories (μm)	% of total traverse length	Cumulative %
0 to <20	0.54	0.54
20 to <40	2.15	2.69
40 to <60	5.33	8.02
60 to <80	5.16	13.17
80 to <100	5.10	18.27
100 to <120	7.29	25.56
120 to <140	7.82	33.38
140 to <160	4.94	38.32
160 to <180	5.98	44.30
180 to <200	4.85	49.15
200 to <220	5.94	55.10
220 to <240	5.63	60.73
240 to <280	4.68	65.41
280 to <300	5.01	70.43
300 to <320	5.40	75.82
320 to <340	0.86	76.69
340 to <360	3.23	79.92
360 to <380	3.39	83.32
380 to <400	3.61	86.93
400 to <420	1.62	88.55
420 to <440	1.73	90.28
440 to <460	2.39	92.67
460 to <480	1.88	94.55
480 to <500	1.31	95.86
500 and >	4.14	100.00

Table 13-4: Data for micro-pore size distribution plot shown in Figure 13-3.

Size categories (µm)	Area %	Cumulative %
0 to <1	0.39	13.60
1 to <2	0.82	41.77
2 to <3	0.51	59.45
3 to <4	0.35	71.40
4 to <5	0.24	79.76
5 to <6	0.16	85.19
6 to <7	0.11	88.85
7 to <8	0.08	91.67
8 to <9	0.05	93.25
9 to <10	0.06	95.27
10 to <15	0.08	97.92
15 to <20	0.05	99.53
20 to <100	0.01	100.00
100 and >	0.00	100.00
sum	2.90	

Table 13-5: Composition as determined by x-ray fluorescence:

Oxide/element	wt%
MgO	8.44
Al_2O_3	18.61
SiO_2	45.53
S	0.02
CaO	11.81
Fe_2O_3	13.13
sum	97.54

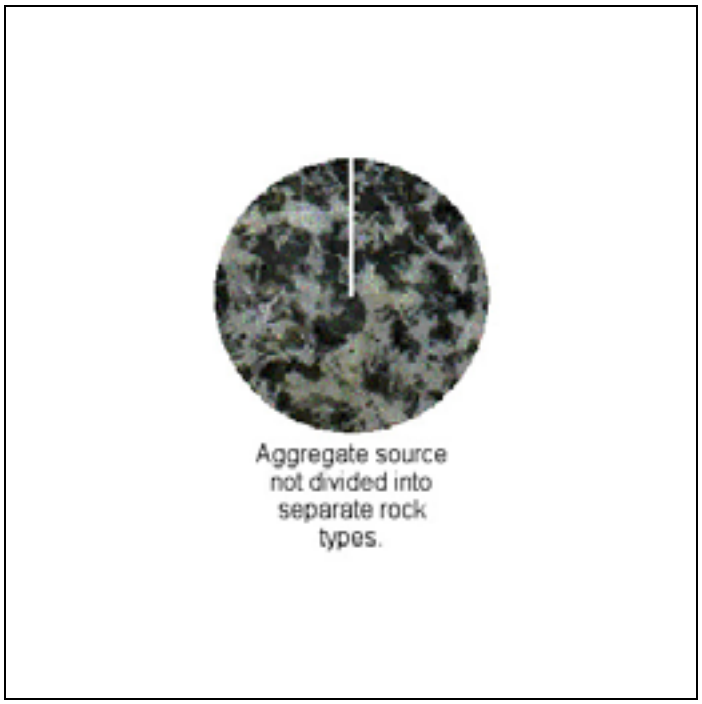


Figure 13-4: Rock types within aggregate source based on differences in color and texture.

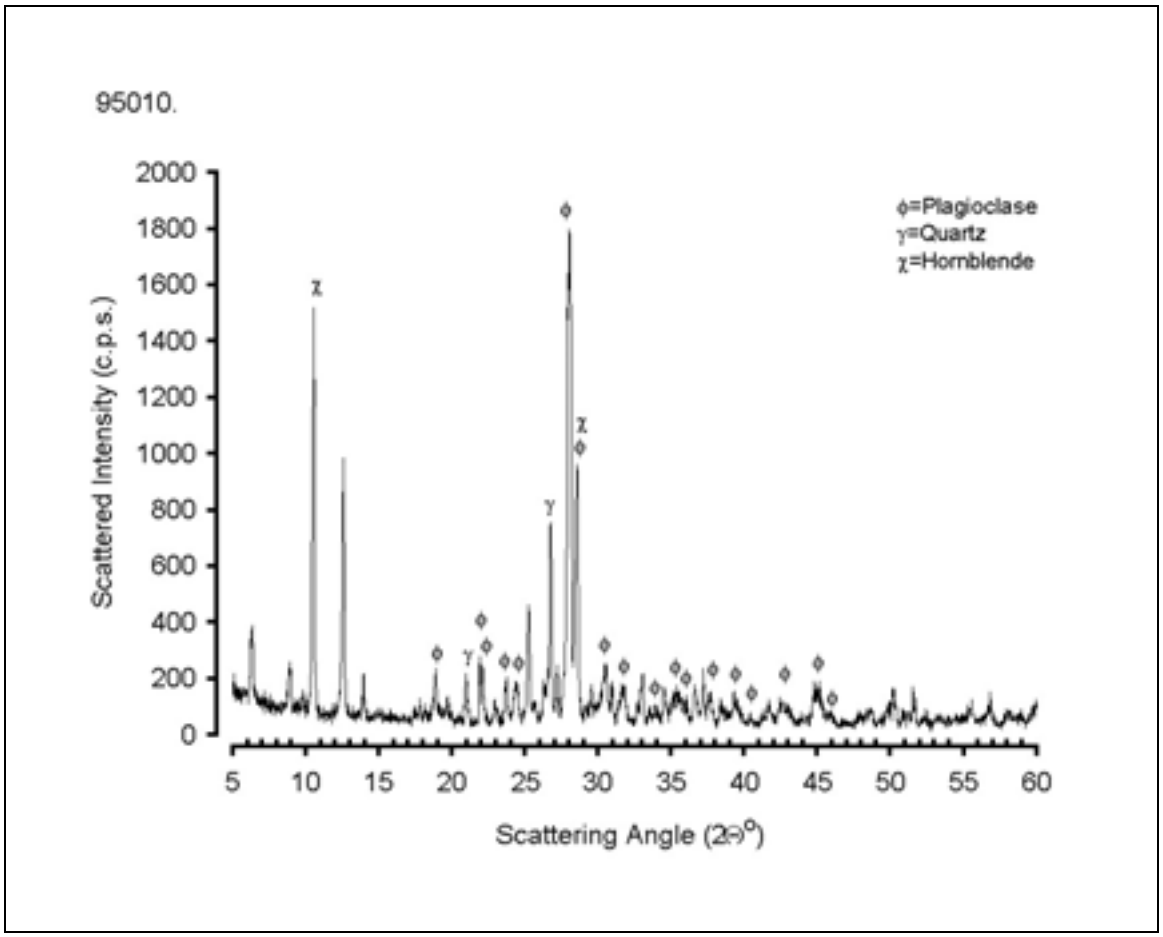


Figure 13-5: X-ray diffraction pattern from aggregate source.

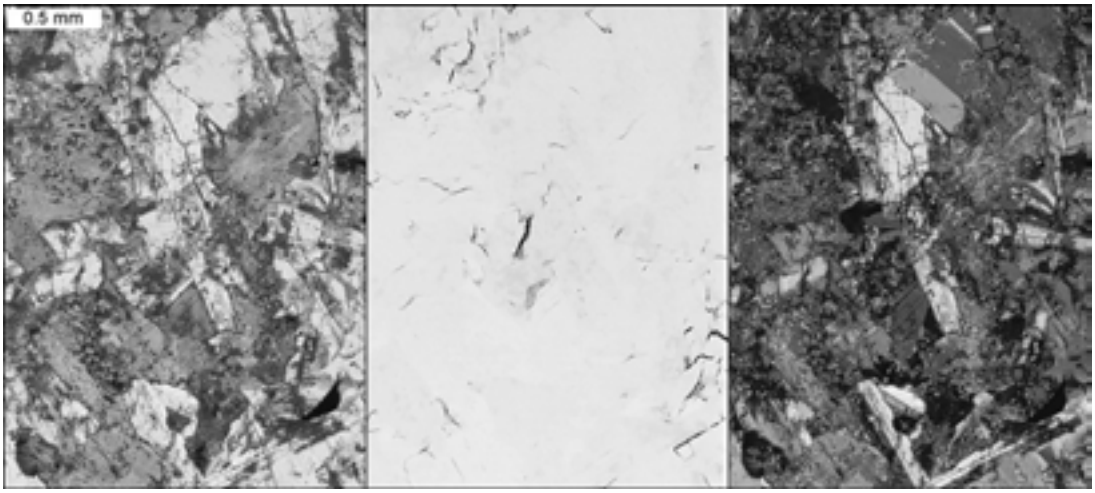


Figure 13-6a: Thin section micrographs for Type I, from left to right: transmitted light, epifluorescent illumination, (darker regions equate to higher porosity) and transmitted light with crossed polars.

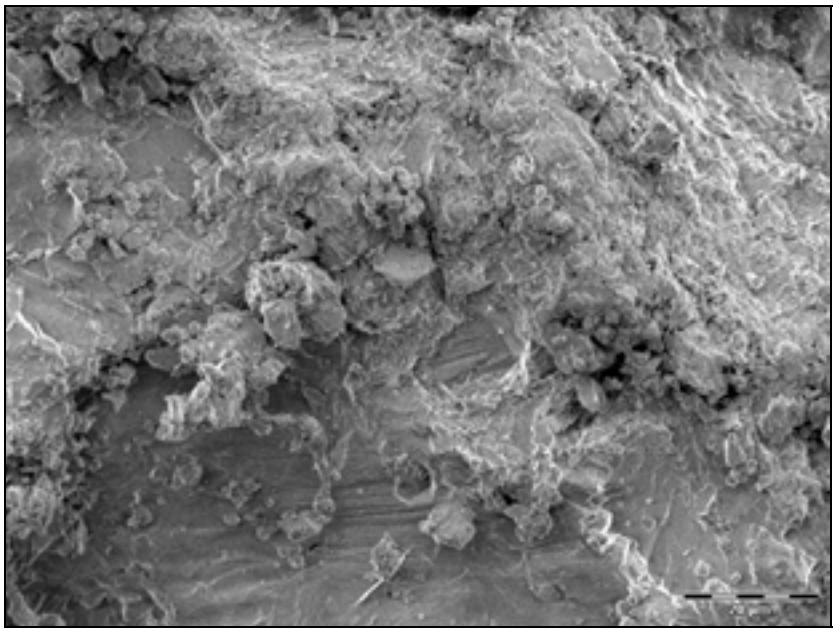


Figure 13-7a: ESEM photo of fracture surface.

Table 13-6: Grain intercept length statistics:

Grain intercept length (μm)	
Average	149.2
Median	110.6
Standard deviation	133.1
Maximum	939.4
Minimum	5.5

Table 13-7: Micro-pore diameter statistics:

Micro-pore diameter (μm)	
Average	1.44
Median	1.06
Standard deviation	1.26
Maximum	37.42
Minimum	0.60