APPENDIX G – CORE AND THIN SECTION DATA FOR JONES & LAUGHLIN #1, BEAVER COUNTY, PENNSYLVANIA

Sample Number	Formation	Depth (ft)	Earlougher Engineering		PAGS	
			Permeability (mD)	Porosity (%)	Permeability (mD)	Porosity (%)
1	Huntersville Chert	5250	0.01	0.14	0.174	0.074
10	Huntersville Chert	5258	0	0.14	0.19	0.025
20	Huntersville Chert	5268	0	0.43	0.671	0.228
30	Huntersville Chert	5346	0	0.58	0.185	0.052
40	Huntersville Chert	5356	0	0.14	0.188	0.144
49	Huntersville Chert	5366	0	0.14	0.196	0.039
60	Oriskany Sandstone	5385	0	0.43	0.192	0.199
61	Oriskany Sandstone	5386			0.199	0.026
62	Oriskany Sandstone	5387			0.199	0.367
63	Oriskany Sandstone	5388	0.04		0.191	0.605
64	Oriskany Sandstone	5389	0		0.218	0.029
65	Oriskany Sandstone	5390	0.07		0.314	1.04
66	Oriskany Sandstone	5391	0		0.221	1.03
67	Oriskany Sandstone	5392	0.2		0.323	2.61
68	Oriskany Sandstone	5393	3.3		1.27	4.38
69	Oriskany Sandstone	5394	0.94		2.23	5.19
70	Oriskany Sandstone	5395	1.2	4.8	1.74	4.36
71	Oriskany Sandstone	5396	0.68		1.04	4.26
	Oriskany Sandstone	5397-5403	No core samples			
72	Oriskany Sandstone	5404	2.3		1.94	4.73
73	Oriskany Sandstone	5405	3		3.27	4.88
74	Oriskany Sandstone	5406	4.2		4.59	5.36
75	Oriskany Sandstone	5407	2.7	5.5	3.15	4.35
76	Oriskany Sandstone	5408	1.9		2.07	5.03
77	Oriskany Sandstone	5409	3.4		4.56	5.44
78	Oriskany Sandstone	5410	1.8		2.66	6.44
79	Oriskany Sandstone	5411	3.1		3.83	5.6
80	Oriskany Sandstone	5421	0.01	2.0	0.251	0.865
81	Oriskany Sandstone	5422	0.08		0.333	3.1
82	Oriskany Sandstone	5423	0.03		0.295	2.31
83	Oriskany Sandstone	5424	0.02		0.243	1.01
84	Oriskany Sandstone	5425	0.02		0.285	1.02
85	Oriskany Sandstone	5426	0.01	1.2	0.248	1.81

Core No.	Formation	Depth (ft)	Dry Weight (g)	Wet Weight (g)	Difference (g)	Bulk Volume (cc)	Pore Volume (cc)	Porosity (%)
41	Huntersville Chert	5357	34.7149	34.7162	0.0013	12.95	0.00173	0.013
42	Huntersville Chert	5358	25.14	25.1425	0.0025	9.311	0.00333	0.036
43	Huntersville Chert	5359	30.4366	30.4421	0.0055	11.345	0.00733	0.065
44	Huntersville Chert	5360	32.4891	32.493	0.0039	12.033	0.00919	0.043
45	Huntersville Chert	5361	35.2397	35.2419	0.0022	12.95	0.00293	0.023
46	Huntersville Chert	5363	31.8703	31.8725	0.0022	11.8038	0.00293	0.025
47	Huntersville Chert	5364	14.4666	14.4798	0.0032	5.358	0.00426	0.08
48	Huntersville Chert	5365	31.2625	31.2665	0.004	11.746	0.00533	0.045
49	Huntersville Chert	5366	32.0247	32.0282	0.0035	11.861	0.00966	0.039
50	Huntersville Chert	5367	15.4	15.4058	0.0058	6.303	0.00773	0.123
51	Huntersville Chert	5368	30.6315	30.6377	0.0062	11.345	0.00826	0.073
52	Huntersville Chert	5369	29.8562	29.8581	0.0019	11.303	0.00253	0.023
53	Huntersville Chert	5370	18.1427	18.1447	0.002	6.818	0.00266	0.039
54	Huntersville Chert	5371	34.398	34.4038	0.005	12.692	0.00666	0.052
55	Huntersville Chert	5380	17.3848	17.3874	0.0026	6.532	0.00346	0.053
56	Huntersville Chert	5381	29.1627	29.1665	0.0038	10.801	0.0051	0.047
57	Huntersville Chert	5382	33.3341	33.34	0.0059	12.549	0.00786	0.063
58	Huntersville Chert	5383	18.9513	18.9544	0.0031	7.019	0.00413	0.059
59	Oriskany Sandstone	5384	27.6939	27.6979	0.004	10.257	0.00533	0.052
60	Oriskany Sandstone	5385	32.7926	32.8109	0.0183	12.262	0.02437	0.199
61	Oriskany Sandstone	5386	37.6074	37.6101	0.0027	13.809	0.0036	0.026
62	Oriskany Sandstone	5387	33.5575	33.5919	0.0344	12.491	0.0458	0.367
63	Oriskany Sandstone	5388	29.7823	29.8391	0.0568	11.059	0.0757	0.685
64	Oriskany Sandstone	5389	37.5406	37.5436	0.003	13.695	0.004	0.029
65	Oriskany Sandstone	5390	28.9666	29.0516	0.085	10.881	0.113	1.04
66	Oriskany Sandstone	5391	33.9981	34.0976	0.0995	12.778	0.132	1.03
67	Oriskany Sandstone	5392	34.5054	34.7628	0.2574	13.112	0.3429	2.61
68	Oriskany Sandstone	5393	33.7255	34.1572	0.4317	13.112	0.575	4.38
69	Oriskany Sandstone	5394	34.491	35.0187	0.5277	13.551	0.7029	5.19
70	Oriskany Sandstone	5395	34.2145	34.6511	0.4366	13.351	0.5816	4.36
71	Oriskany Sandstone	5396	34.0314	34.4534	0.422	13.208	0.5621	4.26
			2 feet, unmarked cores					
72	Oriskany Sandstone	5404	34.3839	34.8603	0.4764	13.408	0.6346	4.73
73	Oriskany Sandstone	5405	30.5221	31.0323	0.5102	12.033	0.6796	4.82
74	Oriskany Sandstone	5406	32.6152	33.1301	0.5149	12.807	0.6859	5.36
75	Oriskany Sandstone	5407	33.9678	34.4769	0.5091	13.294	0.6781	4.35
76	Oriskany Sandstone	5408	30.7374	31.1907	0.4533	12.004	0.6038	5.03
77	Oriskany Sandstone	5409	31.6332	32.1394	0.5062	12.405	0.6743	5.44
78	Oriskany Sandstone	5410	33.364	34.0002	0.6362	13.15	0.8474	6.44
79	Oriskany Sandstone	5411	34.3147	34.8811	0.5664	13.466	0.7544	5.6
80	Oriskany Sandstone	5421	35.1305	35.2165	0.086	13.236	0.1145	0.856

Thin Section Analysis Report

Sample ID: 0-2 JL-1-A
Formation/Member Name: Oriskany Sandstone Beaver County, PA
Lithologic Classification: Sandstone
Depth/Depth Range: 5383 ft
Date of Analysis: 6/7/2017
Analyzed by: Ellen Davis

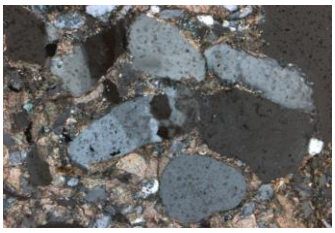
observed at 10x

Texture		Comments
Grain Size	50-800 µm, average grain size ~300 µm	
Rounding	subangular, subrounded	
Sorting	moderately to poorly sorted	

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		images 02_0002, 02_0004, 02_0009 - 02_0013
Monocrystalline	~80% monocrystalline quartz ·larger, subrounded to rounded grains ·many smaller subangular grains ·not much overgrowth ·primarily subhedral with moderate relief	
Microcrystalline	grains can be easily observed under petroscope XN: black, white, gray PPL: light brown *small holes present; could just be the image	
Feldspar		
Plagioclase	·albite twinning present	images 02_0001, 02_0006, 02_0007
Orthoclase	N/A	
Microcline	·tartan twinning present	image 02_0008
Carbonate		
Calcite	~20% calcite ·moderate relief ·primarily cementing material/overgrowth ·primarily anhedral XN: brown, green, pink PPL: light brown	images 02_0017 - 02_0023
Dolomite	N/A	
Aragonite	N/A	
Clay		
Illite	N/A	
Smectite	N/A	
Kaolinite	N/A	
Muscovite	<1% muscovite ·small, subrounded to rounded grains XN: blue, purple, orange PPL: gray-green	
Chlorite	N/A	
Glauconite	N/A	
Rock Fragments		
Sedimentary		
Volcanic	N/A	
Metamorphic	N/A	
Other (Accessory Minerals)		
Uncertainties	image 02_0005	

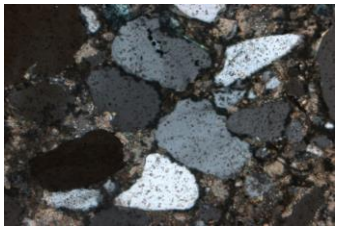
Cementing Materials		Comments
Quartz		
Feldspar		
Carbonate	·primarily carbonate cementing	images 02_0025 - 02_0030
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other		

Visual Porosity Estimate	Comments
difficult to determine porosity due to absence of dye	



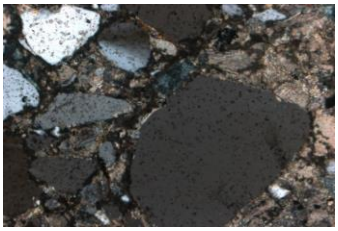
This XN image shows subangular quartz grains varying from smaller to larger grain sizes. The image also contains polycrystalline quartz although it makes up a small percentage of the sample's composition.

(10x, XN)



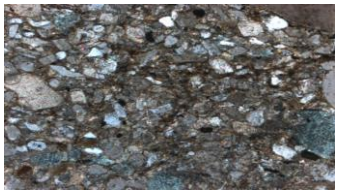
This image shows subangular and subrounded quartz grains with medium relief. The quartz is in a matrix of calcite and does not show much overgrowth.

(10x, XN)



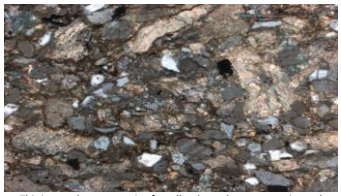
This is a larger quartz grain, embedded in a matrix of calcite and smaller quartz grains.

(10x, XN)



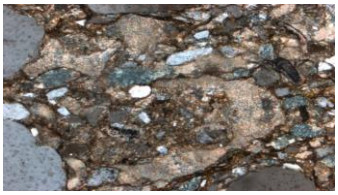
This image shows much smaller quartz grains surrounded by cementing calcite.

(10x, XN)



This image shows a matrix of small, subangular quartz grains and calcite.

(10x, XN)



A large section of calcite is shown in this image. Here, smaller quartz grains are cemented by the calcite.

(10x, XN)



Under XN, this image shows calcite as a one of the primary minerals in the sample as well as the predominant cementing material.

(10x, XN)



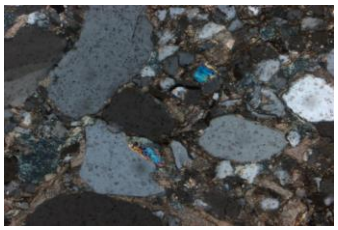
This image shows a large grain of calcite surrounded by cementing calcite and larger quartz grains.

(10x, XN)



This image shows subangular birefringent muscovite in a matrix of small quartz grains and calcite cement.

(10x, XN)



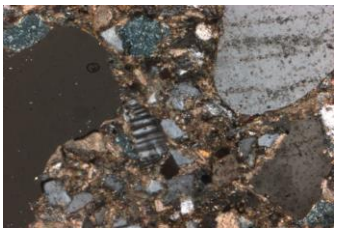
The small, brightly-colored minerals in this XN image are grains of muscovite.

(10x, XN)



The tartan twinning in this image shows the presence of microcline feldspar.

(10x, XN)



This image of plagioclase feldspar shows albite twinning. The striped pattern is visible under XN.

(10x, XN)

Thin Section Analysis Report

Sample ID: 0-3-A JL-1-A
Formation/Member Name: Oriskany Sandstone Beaver County, PA
Lithologic Classification: Sandstone
Depth/Depth Range: 5384 ft
Date of Analysis: 6/7/2017
Analyzed by: Ellen Davis

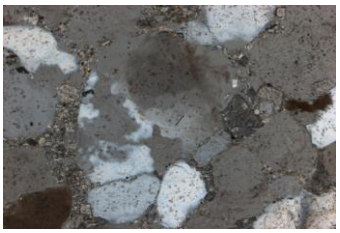
observed at 10x

Texture		Comments
Grain Size	100-700 µm, average grain size ~350µm	
Rounding	subrounded to rounded	
Sorting	well sorted	

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		images 03A_0002 - 03A_0004, 03A_0006 - 03A_0009
Monocrystalline	~95% quartz ·mostly large, subrounded to rounded grains ·small holes present in grains ·overgrowth is present some polycrystalline as well) ·subhedral with moderate relief	
Microcrystalline	grains can be easily observed under petroscope	
	XN: black, white, gray PPL: light brown	
Feldspar		
Plagioclase	N/A	
Orthoclase	N/A	
Microcline	·tartan twinning present	image 03A_0015
Carbonate		
Calcite	~5% calcite ·primarily cementing material/overgrowth ·anhedral grains	
		images 03A_0010 - 03A_0014
	XN: brown, green, pink PPL: light brown/gray	
Dolomite	N/A	
Aragonite	N/A	
Clay		
Illite	N/A	
Smectite	N/A	
Kaolinite	N/A	
Muscovite	<1% muscovite ·small grains ·subrounded to rounded grains	images 03A_0016, 03A_0017
	XN: blue, green, orange, pink PPL: green/gray	
Chlorite	N/A	
Glauconite	N/A	
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		
Uncertainties	image 03A_0005	

Cementing Materials		Comments
Quartz	·overgrown quartz and calcite present	images 03A_0018 - 03A_0023
Feldspar		image 03A_0001
Carbonate		
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other	·possibly mud present?	

Visual Porosity Estimate	Comments
absence of dye limited accuracy of porosity estimate	



This image shows the primary composition of this sample: overgrown quartz. With XN, polycrystalline grains can be seen among the overgrowth.

(10x, XN)



The quartz grains in this image are overgrown, forming a cementing material. There is some calcite present but the matrix is primarily quartz.

(10x, XN)



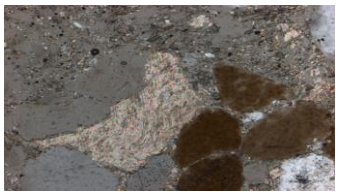
This is a particularly large quartz grain and other large, overgrown quartz grains. Some cementing calcite is also shown.

(10x, XN)



This image shows one of the larger grains of calcite in this sample under XN. Smaller bits of calcite can also be seen between the quartz grains in this image.

(10x, XN)



The large grain of calcite in this image is embedded in overgrown quartz and some smaller grains of calcite.

(10x, XN)



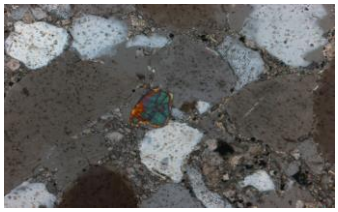
Although the compostion of this sample is primarily overgrown quartz, this image shows a large grain of calcite cemented by overgrown quartz.

(10x, XN)



The tartan twinning in this image shows the presence of microcline feldspar, here cemented by quartz grains.

(10x, XN)



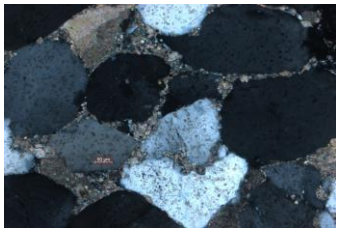
This image shows a grain of brightly colored muscovite in a matrix of overgrown quartz and calcite.

(10x, XN)



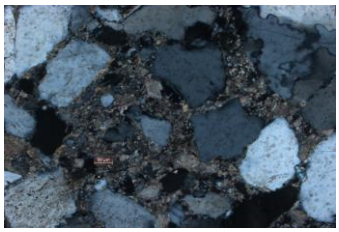
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(10x, XN)



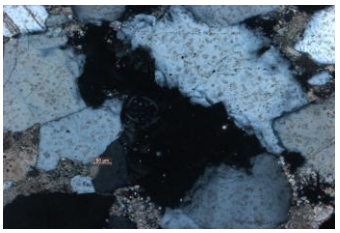
This image shows calcite separating subrounded and subanglar quartz grains.

(10x, XN)



These are small quartz grains embedded in calcite. Some overgrown quartz is also present in the top-left of this image.

(10x, XN)



This overgrown quartz is the predominant mineral in the sample. The overgrowth cements larger grains of calcite.

(10x, XN)

Thin Section Analysis Report

Sample ID: 0-3-B JL-1-A
Formation/Member Name: Oriskany Sandstone Beaver County, PA
Lithologic Classification: Sandstone
Depth/Depth Range: 5384 ft
Date of Analysis: 6/9/2017
Analyzed by: Ellen Davis

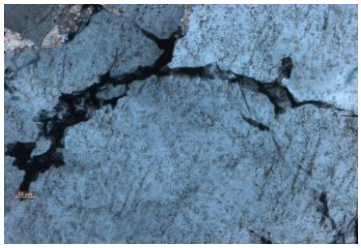
observed at 10x

Texture		Comments
Grain Size	50-900 µm, average grain size ~450 µm	
Rounding	subangular to subrounded	
Sorting	moderately to well sorted	

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		images 03B_0003 - 03B_0009, 03B_0012
Monocrystalline	~85% quartz ·subangular to subrounded grains ·primarily larger than the other grains ·large amounts of overgrowth ·mostly subhedral grains ·small holes are present in grains	
Microcrystalline	grains can be easily observed under petroscope	
	XN: black, white, gray PPL: light brown	
Feldspar		
Plagioclase	<1% feldspar ·albite twinning ·small, subhedral grains	images 03B_0001, 03B_0010, 03B_0020
Orthoclase	N/A	
Microcline	N/A	
Carbonate		
Calcite	~15% calcite ·primarily anhedral cementing material	images 03B_0011, 03B_0013 - 03B_0018
	XN: brown, green, pink PPL: light brown/gray	
Dolomite	N/A	
Aragonite	N/A	
Clay		
Illite	N/A	
Smectite	N/A	
Kaolinite	N/A	
Muscovite	<1% muscovite ·small, rounded grains	images 03B_0019, 03B_0021, 03B_0024
	XN: blue, orange, pink, green PPL: yellow-green/brown	
Chlorite	N/A	
Glauconite	N/A	
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

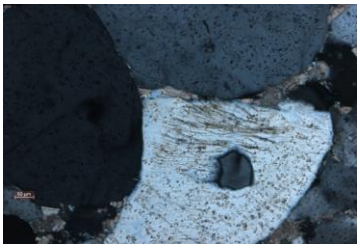
Cementing Materials		Comments
Quartz	·overgrown quartz and calcite cementing	images 03B_0002, 03B_0023, 03B_0025 - 03B_0029
Feldspar		
Carbonate		
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other	·mud possibly present(?)	

Visual Porosity Estimate	Comments
no dye made it difficult to determine porosity	



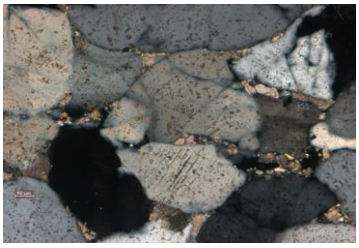
This image shows large, subhedral quartz grains. Quartz comprises 85% of this sample.

(10x, XN)



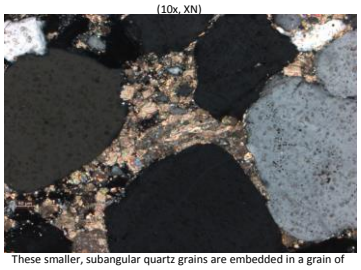
These quartz grains are large, subhedral and subrounded. Some quartz overgrowth is shown as well.

(10x, XN)



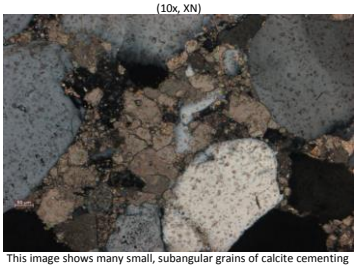
This image shows overgrown quartz and some smaller grains of calcite embedded in it.

(10x, XN)



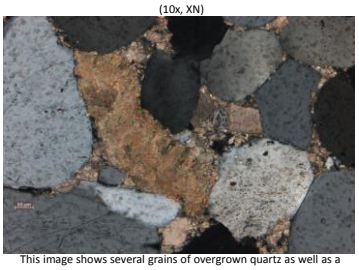
These smaller, subangular quartz grains are embedded in a grain of calcite. Larger, subrounded quartz grains are also shown.

(10x, XN)



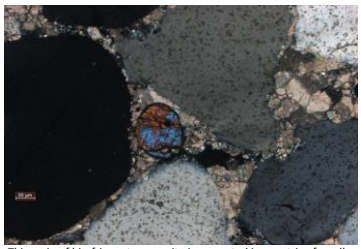
This image shows many small, subangular grains of calcite cementing quartz grains.

(10x, XN)



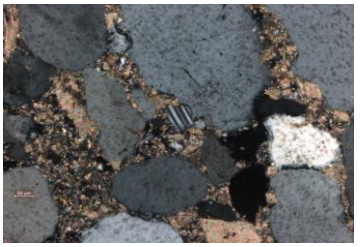
This image shows several grains of overgrown quartz as well as a large grain of calcite. Some smaller grains of calcite cement the overgrown quartz.

(10x, XN)



This grain of birefringent muscovite is cemented in a matrix of small, subangular calcite and large grains of quartz.

(10x, XN)



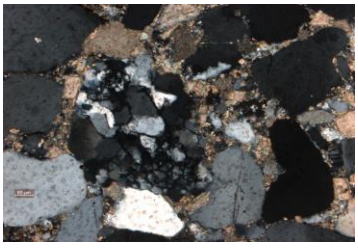
The albite twinning shown in this image is due to plagioclase feldspar. The feldspar is cemented in a matrix of quartz and calcite.

(10x, XN)



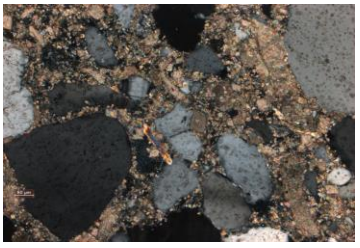
This image shows plagioclase feldspar with albite twinning surrounded by calcite and large, subrounded quartz.

(10x, XN)



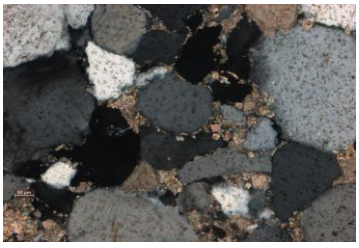
This is an image of polycrystalline quartz. Small grains of calcite and larger grains of monocrystalline quartz surround the polycrystalline quartz.

(10x, XN)



These subangular and subrounded quartz grains are in a matrix of calcite and smaller quartz grains. There is also a small grain of muscovite in the center of the image.

(10x, XN)



Overgrown quartz is shown in this image, surrounded by calcite.

(10x, XN)

Thin Section Analysis Report

Sample ID: 0-4 JL-1-A
Formation/Member Name: Oriskany Sandstone Beaver County, PA
Lithologic Classification: Sandstone
Depth/Depth Range: 5387 ft
Date of Analysis: 6/12/2017
Analyzed by: Ellen Davis

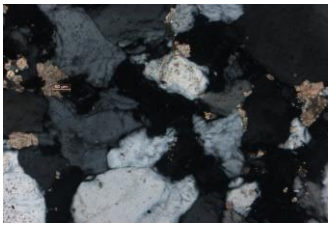
observed at 10x

Texture		Comments
Grain Size	50-800 µm, average grain size ~300 µm	
Rounding	subangular to subrounded, subhedral	
Sorting	moderately to well sorted	

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		images 04_0001 - 04_0005, 04_0007 - 04_0009
Monocrystalline	~95% quartz ·subangular to subrounded grains ·medium grain size ·abundant overgrowth; polycrystalline grains	
Microcrystalline	grains can be easily observed under petroscope	
	XN: black, white, gray PPL: light brown	
Feldspar		
Plagioclase	·albite twinning present	image 04_0016
Orthoclase	N/A	
Microcline	·tartan twinning present	image 04_0015
Carbonate		
Calcite	<5% calcite ·medium, subhedral grains ·mostly anhedral	images 04_0011 - 04_0014, 04_0018, 04_0019
	XN: brown, green, pink PPL: light brown/gray	
Dolomite		
Aragonite		
Clay		
Illite	N/A	
Smectite	N/A	
Kaolinite	N/A	
Muscovite	<1% muscovite ·small, subrounded to rounded grains	image 04_0017
	XN: blue, orange, pink PPL: yellow-green/gray	
Chlorite	N/A	
Glauconite	N/A	
Rock Fragments		
Sedimentary	some sedimentary rock fragments present	image 04_0006 (SRF?)
Volcanic		
Metamorphic		
Other (Accessory Minerals)		
Uncertainties	04_0010 (right side), 04_0023 (unknown circles)	

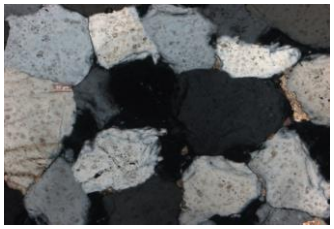
Cementing Materials		Comments
Quartz	·mostly overgrown quartz	images 04_0020 - 04_0022, 04_0024 - 04_0025
Feldspar		
Carbonate	·some calcite present	
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other		

Visual Porosity Estimate	Comments
difficult to determine porosity due to absence of dye	



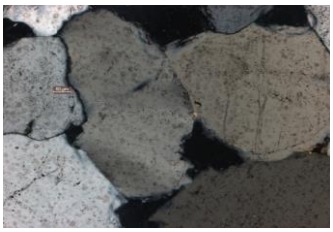
This sample is about 95% quartz and this image shows subhedreal, overgrown quartz grains. Some grains of calcite are also present.

(10x, XN)



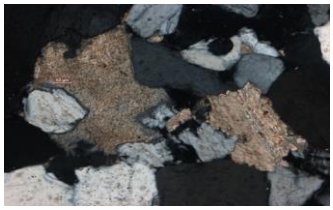
This image shows subangular, overgrown quartz cementing several smaller grains of calcite.

(10x, XN)



These large, subrounded/subangular quartz grains are overgrown with only some void space separating the grains.

(10x, XN)



These two large grains of subhedral calcite are cemented by overgrown quartz.
(10x, XN)

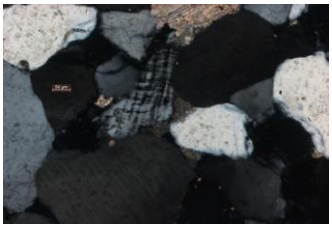


This image shows a grain of calcite surrounded by subrounded grains of overgrown quartz.
(10x, XN)



A matrix of overgrown quartz surrounds a grain of ahedral calcite.

(10x, XN)



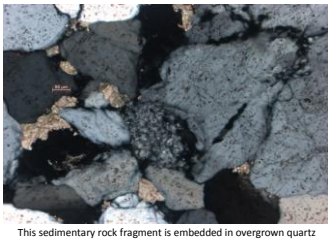
This is an image of microcline feldspar with tartan twinning in a matrix of overgrown quartz. Some calcite is also shown in this image.

(10x, XN)



This image shows a subrounded grain of plagioclase feldspar with albite twinning. A small grain of muscovite is in the top right corner.

(10x, XN)



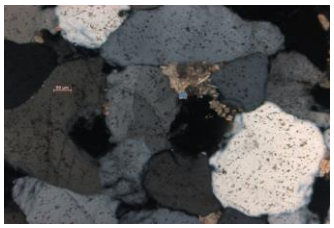
This sedimentary rock fragment is embedded in overgrown quartz grains with some small grains of calcite also present.

(10x, XN)



This image shows overgrown quartz cementing grains of calcite.

(10x, XN)



These small grains of calcite are surrounded by subrounded and subangular overgrown quartz. Some void space is shown as well.

(10x, XN)



This image shows subhedral, overgrown quartz grains along with some void space.

(10x, XN)

Thin Section Analysis Report

Sample ID: 0-5 JL-1-A
Formation/Member Name: Oriskany Sandstone Beaver County, PA
Lithologic Classification: Sandstone
Depth/Depth Range: 5388 ft
Date of Analysis: 6/12/2017
Analyzed by: Ellen Davis

observed at 10x

Texture		Comments
Grain Size	100-800 µm, average grain size ~300 µm	
Rounding	subangular to subrounded grains; subhedral	
Sorting	moderately to poorly sorted grains	

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		images 05_0003 - 05_0009
Monocrystalline	~90% quartz ·abundant overgrowth ·subangular to subrounded grains ·mostly subhedral	
Microcrystalline	grains can be easily observed under petroscope	
	XN: black, white, gray PPL: light brown	
Feldspar		
Plagioclase	N/A	
Orthoclase	N/A	
Microcline	N/A	
Carbonate		
Calcite	~10% calcite	images 05_0010 - 05_0013, 05_0015 - 05_0016
	XN: brown, green, pink PPL light brown/gray	
Dolomite		
Aragonite		
Clay		
Illite	N/A	
Smectite	N/A	
Kaolinite	N/A	
Muscovite	<5% muscovite ·small, angular-subangular grains	images 05_0006
	XN: blue, orange, pink PPL: gray-brown	
Chlorite	N/A	
Glauconite	N/A	
Rock Fragments		
Sedimentary	sedimentary rock fragments present in thin section	images 05_0001 (SRF)
Volcanic		
Metamorphic		
Other (Accessory Minerals)		
Uncertainties	05_0014	

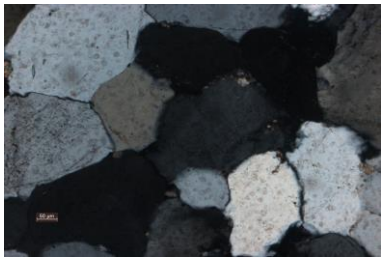
Cementing Materials		Comments
Quartz	·primarily overgrown quartz	images 05_0018 - 05_0023
Feldspar		
Carbonate	·some (not much) calcite cementing	
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other	·possibly mud	

Visual Porosity Estimate	Comments
lack of dye makes it difficult to determine porosity	



This image shows large, subrounded quartz grains. This comprises about 90% of the sample.

(10x, XN)



This image shows subangular and subrounded overgrown quartz grains.

(10x, XN)



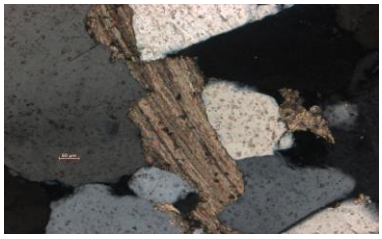
This is a large quartz grain with other overgrown quartz grains surrounding it.

(10x, XN)



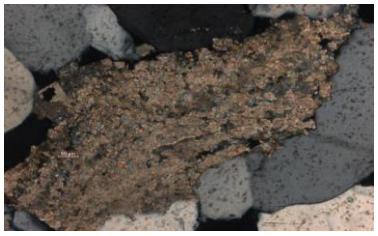
This larger grain of subhedral calcite is in a matrix of overgrown quartz.

(10x, XN)



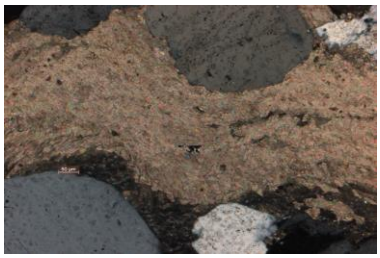
This image shows a strained grain of calcite surrounded by subround and subangular overgrown quartz.

(10x, XN)



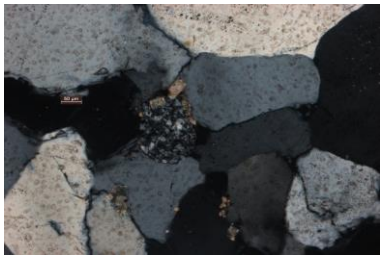
In this image, overgrown quartz surrounds a grain of calcite.

(10x, XN)



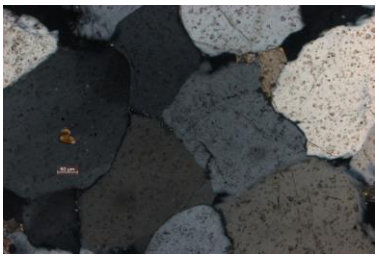
This image shows a matrix of calcite among several subrounded quartz grains.

(10x, XN)



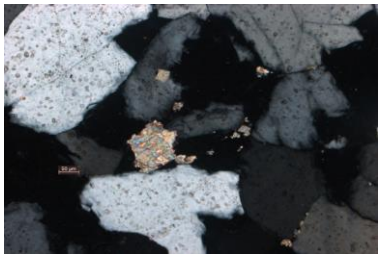
This image shows a sedimentary rock fragment in a matrix of overgrown quartz.

(10x, XN)



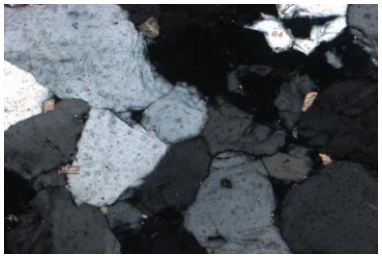
Although only about 50 µm large, this grain of birefringent muscovite is embedded in a grain of quartz. Other overgrown grains of quartz are present in this image.

(10x, XN)



This image shows overgrown quartz, subangular calcite, and pore space in between the grains.

(10x, XN)



This subhedral overgrown quartz is the primary cementing material in this image but some pore space can be seen separating the quartz.

(10x, XN)



This image shows a good example of the overall composition of this sample. A grain of calcite is shown with overgrown quartz and void space.

(10x, XN)

Thin Section Analysis Report

Sample ID: 0-6 JL-1-A
Formation/Member Name: Oriskany Sandstone Beaver County, PA
Lithologic Classification: Sandstone
Depth/Depth Range: 5404 ft
Date of Analysis: 6/13/2017
Analyzed by: Ellen Davis

observed at 10x

Texture		Comments
Grain Size	50-700 µm, average grain size ~350 µm	
Rounding	subangular to subrounded grains; mostly subhedral	
Sorting	moderately sorted	

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		images 06_0004 - 06_0010, 06_0012
Monocrystalline	~90% quartz ·large amounts of overgrowth ·subangular to subrounded grains ·mostly subhedral grains ·some polycrystalline quartz	
Microcrystalline	grains can be easily observed under petroscope XN: black, white, gray PPL: light brown	
Feldspar		
Plagioclase	·albite twinning present	image 06_0001
Orthoclase	N/A	
Microcline	·tartan twinning present	image 06_0014
Carbonate		
Calcite		images 06_0013, 06_0015, 06_0017 - 06_0021
	<10% calcite ·medium sized, subhedral grains ·some small grains present XN: brown, green, pink PPL: light brown	
Dolomite	N/A	
Aragonite	N/A	
Clay		
Illite	N/A	
Smectite	N/A	
Kaolinite	N/A	
(?) Muscovite	·small, subangular grains XN: blue, yellow, green PPL: gray-brown	image 06_0068
Chlorite	N/A	
Glauconite	N/A	
Rock Fragments		
Sedimentary	some sedimentary rock fragments	06_0002 (SRF?)
Volcanic		
Metamorphic		
Other (Accessory Minerals)		
Uncertainties	images 06_0026 (4:00), 06_0011 (small, clear/ blue) 06_0016 (clear, yellow)	

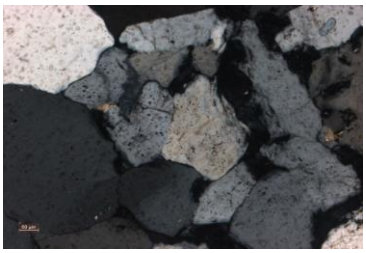
Cementing Materials		Comments
Quartz	·primarily overgrown quartz	images 06_0022 - 06_0025, 06_0027, 06_0029
Feldspar		
Carbonate	·small amounts of calcite	
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other	·some mud (?)	image 06_0003 (mud)

Visual Porosity Estimate	Comments
difficult to estimate porosity due to lack of dye	



This image shows a range of differently sized overgrown quartz grains.

(10x, XN)



The subhedral quartz grains in this image are overgrown, cementing grains of calcite.

(10x, XN)



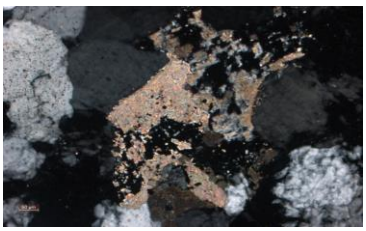
This image shows larger, overgrown quartz grains.

(10x, XN)



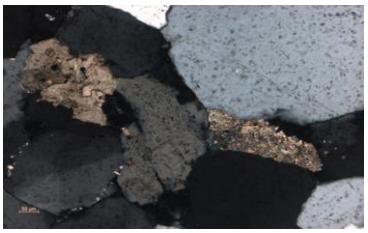
Overgrown quartz surrounds a subhedral grain of calcite.

(10x, XN)



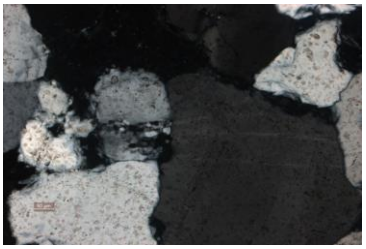
This image shows calcite in a matrix of overgrown quartz and smaller grains of calcite. Some void space can be seen here as well.

(10x, XN)



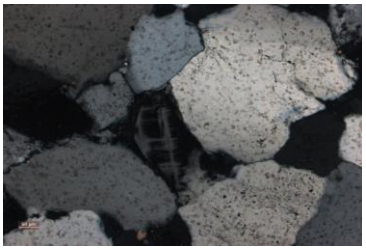
These grains of calcite are embedded in subrounded, overgrown quartz grains.

(10x, XN)



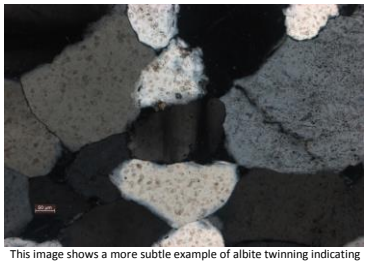
This polycrystalline quartz is in a matrix of overgrown quartz.

(10x, XN)



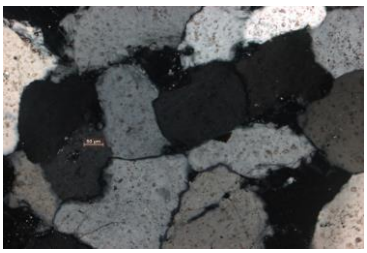
This microcline feldspar with tartan twinning is cemented between subangular and subrounded overgrown quartz.

(10x, XN)



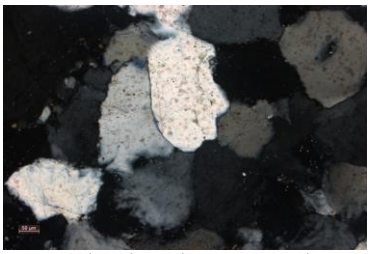
This image shows a more subtle example of albite twinning indicating the presence of plagioclase feldspar. The feldspar is cemented in overgrown quartz.

(10x, XN)



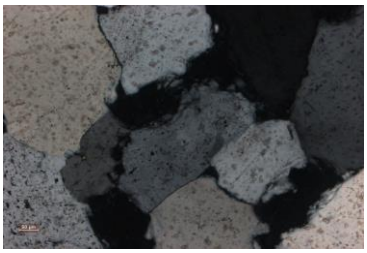
This image shows overgrown quartz as well as pore space inbetween the quartz grains.

(10x, XN)



Pore space can be seen between the overgrown quartz in this image.

(10x, XN)



This image shows subhedral overgrown quartz grains and pore space.

(10x, XN)

Thin Section Analysis Report

Sample ID: 0-7-A JL-1-A
Formation/Member Name: Oriskany Sandstone Beaver County, PA
Lithologic Classification: Sandstone
Depth/Depth Range: 5418 ft
Date of Analysis: 6/13/2017
Analyzed by: Ellen Davis

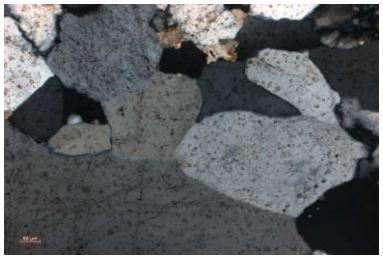
observed at 10x

Texture		Comments
Grain Size	50-500 µm, average grain size ~350 µm	
Rounding	subangular to subrounded	
Sorting	poorly to moderately sorted	

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline	N/A	images 07A_0007 - 07A_0013
Monocrystalline	~60% quartz ·medium sized, overgrown grains ·mostly monocrystalline	
Microcrystalline	grains can be easily observed under petroscope	
	XN: white, black, gray PPL: light brown	
Feldspar		
Plagioclase	·albite twinning present	images 07A_0001, 07A_0002, 07A_0014
Orthoclase	N/A	
Microcline	·tartan twinning present	image 07A_0003 (?)
Carbonate		
Calcite		
	~40% caclite ·large line of calcite running down top of slide ·medium sized grains ·primarily euhedral	images 07A_0015 - 07A_0021
	XN: brown, green, pink PPL: light brown/gray	
Dolomite		
	N/A	
Aragonite	N/A	
Clay		
Illite	N/A	
Smectite	N/A	
Kaolinite	N/A	
Muscovite	<1% muscovite ·small, subangular to subrounded grains	images 07A_0004 - 07A_0006
	XN: orange, blue, pink PPL: green-brown	
Chlorite	N/A	
Glauconite	N/A	
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		
Uncertainties	images 07A_0022, 07A_0023 (black & white, low relief, crystalline)	
	image 07A_0024 (black with calcite, no extinction, smooth PPL, pores?)	

Cementing Materials		Comments
Quartz	·about 50% overgrown quartz	images 07A_0025 - 07A_0030
Feldspar		
Carbonate	·50% calcite	
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other		

Visual Porosity Estimate	Comments
no dye, difficult to determine porosity	



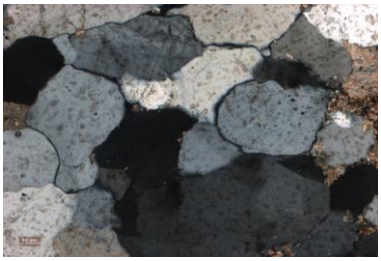
This image shows subrounded overgrown quartz grains ranging in size.

(10x, XN)



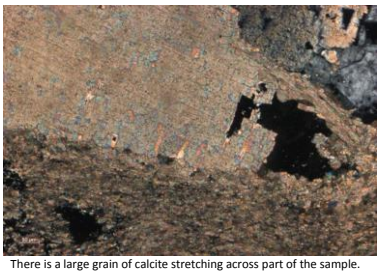
These monocrystalline, overgrown quartz grains cement about 60% of the sample.

(10x, XN)



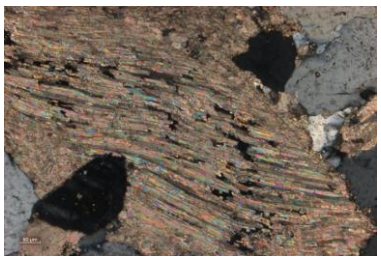
This overgrown quartz cements some smaller grains of calcite.

(10x, XN)



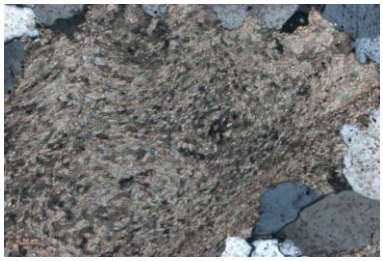
There is a large grain of calcite stretching across part of the sample. This image shows part of that line of calcite. Some pore space is also shown.

(10x, XN)



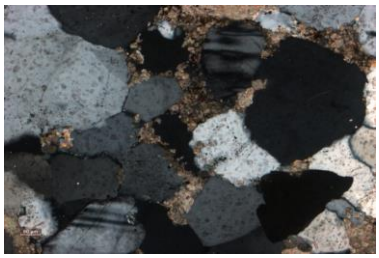
This is another image of calcite in the sample. This calcite is more striated and some quartz grains are also present in the image.

(10x, XN)



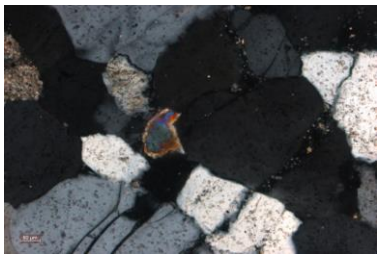
This is also an image of calcite in this sample. The grains are small and there is overgrown quartz embedded in the calcite.

(10x, XN)



This image shows two grains of plagioclase feldspar with albite twining in a matrix of calcite and overgrown quartz.

(10x, XN)



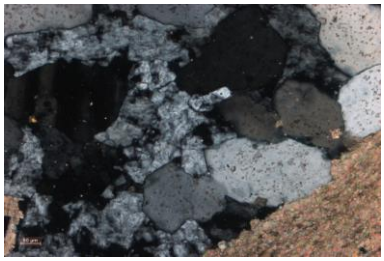
This subangular grain of birefringent muscovite is embedded in a matrix of overgrown quartz.

(10x, XN)



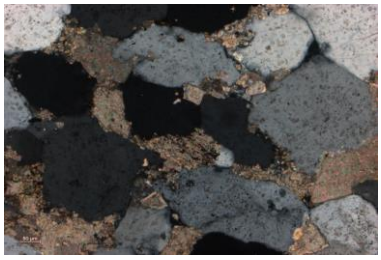
This image shows a small, subrounded grain of birefringent muscovite cemented by overgrown quartz.

(10x, XN)



This image shows polycrystalline quartz, a sedimentary rock fragment. It is surrounded by overgrown quartz.

(10x, XN)



This image is an example of the diverse composition of this sample. Some overgrown quartz is shown and calcite is cementing other quartz grains.

(10x, XN)



Plagioclase feldspar with albite twinning is shown in this image. The feldspar is embedded in a matrix of overgrown quartz.

(10x, XN)

Thin Section Analysis Report

Sample ID: 0-7-B JL-1-A
Formation/Member Name: Oriskany Sandstone Beaver County, PA
Lithologic Classification: Sandstone
Depth/Depth Range: 5418 ft
Date of Analysis: 6/13/2017
Analyzed by: Ellen Davis

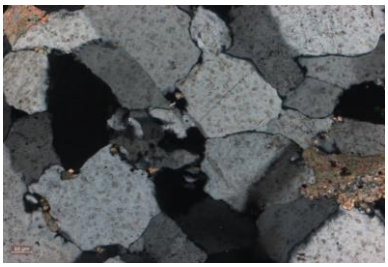
observed at 10x

Texture		Comments
Grain Size	50-500 µm, average grain size ~300 µm	
Rounding	subangular to subrounded	
Sorting	moderately to well mixed	

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		images 07B_0007 - 07B_0013
Monocrystalline	~50% quartz ·wide range of sizes ·overgrowth present ·primarily monocrystalline quartz	
Microcrystalline	grains can be easily observed under petroscope	
	XN: white, black, gray PPL: light brown	
Feldspar		
Plagioclase	·albite twinning	images 07B_0001, 07B_0006
Orthoclase	N/A	
Microcline	·tartan twinning	images 07B_0002, 07B_0004
Carbonate		
Calcite	~50% calcite ·medium sized, anhedral grains	images 07B_0014 - 07B_0019
	XN: brown, green, pink PPL: brown-gray	
Dolomite	N/A	
Aragonite	N/A	
Clay		
Illite	N/A	
Smectite	N/A	
Kaolinite	N/A	
(?) Muscovite	<1% muscovite ·subrounded	images 07B_0003, 07B_0005
	XN: orange, red, yellow, purple	
Chlorite	N/A	
Glauconite	N/A	
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

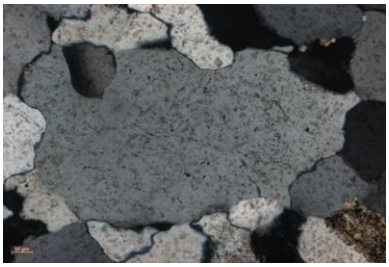
Cementing Materials		Comments
Quartz	·primarily overgrown quartz	images 07B_0020 - 07B_0026
Feldspar		
Carbonate	·some calcite present	
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other		

Visual Porosity Estimate	Comments
difficult to determine porosity, no dye	



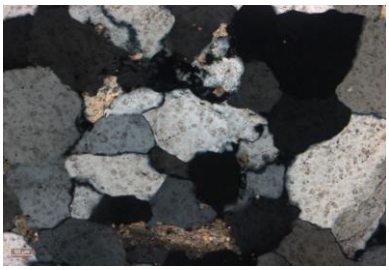
This image shows polycrystalline quartz among overgrown monocrystalline quartz grains.

(10x, XN)



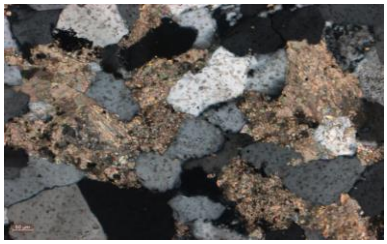
This large grain of quartz is overgrown with smaller quartz grains, cementing grains of calcite.

(10x, XN)



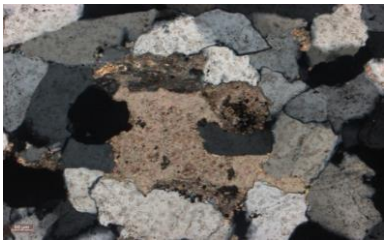
This image shows different sized quartz grains, overgrown with each other and cementing calcite.

(10x, XN)



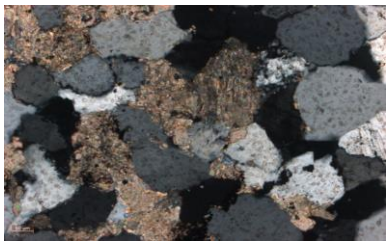
Overgrown quartz in this image is cemented by calcite.

(10x, XN)



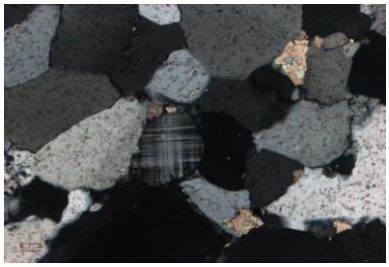
This image shows calcite embedded in grains of subangular, overgrown quartz.

(10x, XN)



This image shows overgrown quartz in a matrix of calcite.

(10x, XN)



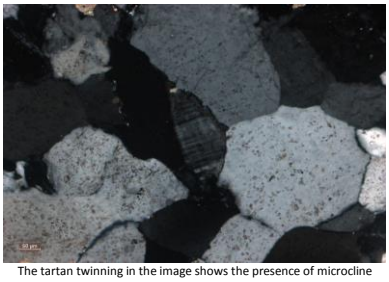
This microcline feldspar with tartan twinning is surrounded by overgrown quartz.

(10x, XN)



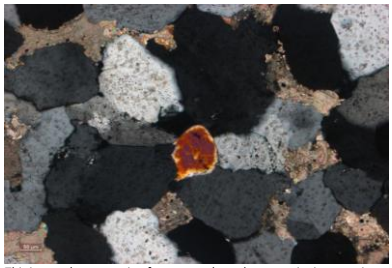
This image shows plagioclase feldspar with albite twinning and is in a matrix of overgrown quartz and calcite.

(10x, XN)



The tartan twinning in the image shows the presence of microcline feldspar. This feldspar is embedded in overgrown quartz.

(10x, XN)



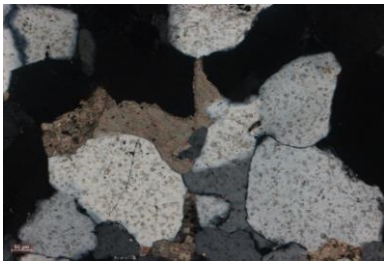
This image shows a grain of orange and purple muscovite in a matrix of overgrown quartz, calcite, and some pore space.

(10x, XN)



This image shows two subangular grains of birefringent muscovite surrounded by subrounded grains of quartz and calcite.

(10x, XN)



Both the calcite and the overgrown quartz act as cementing materials in this image. Some pore space can also be seen.

(10x, XN)