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STATE OF ARKANSAS
ARKANSAS GEOLOGICAL SURVEY
BEKKI WHITE, DIRECTOR AND STATE GEOLOGIST

OPEN-FILE REPORT 2018-2000

SCANNING ELECTRON MICROSCOPE ANALYSIS OF THE LOWER SMACKOVER
FORMATION, ANADARKO TALLEY #1-22, COLUMBIA COUNTY, ARKANSAS

Peng Li and Ciara Mills



July 2018

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Disclaimer

This publication is a preliminary compilation of selected industry reports that were provided to the Arkansas Geological Survey. These reports are compiled in their entirety in this Open-File Report with the express purpose of disseminating scientific information to the general public. The Arkansas Geological Survey does not endorse any company listed in this publication and does not provide a technical opinion regarding the nature and quality of the test results. Service company logos are retained in the original industry reports to disclose the name and location of testing laboratories.

Introduction

This report includes scanning electron microscope (SEM) analysis of four samples from the Anadarko Talley #1-22 well (API: 03-027-11054-0000, Sec.22-T18S-R19W) in Columbia County (Figure 1). The purpose of this analysis is to calculate volumetric percentages of organic matter, porosity, porosity in organic matter, and high density materials in order to determine reservoir quality and mineralogy of the lower part of the Upper Jurassic (Oxfordian) Smackover Formation.

The Smackover Formation in southern Arkansas has been divided into two members: an upper member consisting mainly of white to brown oolitic to chalky, porous limestone and a lower member known as the Brown Dense composed of gray to brown, dense limestone with argillaceous bands (Weeks, 1938; Imlay, 1949; Vestal, 1950). Four sample slabs from the Brown Dense (referred to as plug samples in this publication) were selected for analysis based on changes in bulk density (RHOB) and photoelectric factor (PEF), and were distributed along the core to reflect dominant rock characteristics (Figure 2). All plug samples were photographed in white light and analyzed with X-

ray fluorescence (XRF) in order to determine mineralogy based on weight percent of major elements plus thorium and uranium. Five readings were taken on each sample parallel to the vertical axis of the well across laminations and plotted on an XRF ternary diagram. X-ray projection images were taken with an X-ray CT system at resolutions of 14 microns/pixel and 4 microns/pixel. XRF location points are reported as numbers in the 14 microns/pixel images. Laminations are oriented approximately horizontal along the X-axis in each image, with the Z-axis parallel to the vertical axis of the well and the Y-axis perpendicular to both the X and Z axes (Figure 3).

Small amounts of material were removed from each of the four plug samples, ion polished, and imaged with Ingrain's SEM system to produce 2D SEM images at 15 nanometers per pixel. Images were taken along the YZ plane of the samples and analyzed to calculate quantities of organic matter, porosity, porosity in organic matter, and high density materials. See Appendix 1 for higher resolution 2D SEM images.

Cores were delivered from the Norman F. Williams Well Sample Library of the Arkansas Geological Survey to Ingrain's Digital Rock Physics Lab in Houston, Texas. Plug samples were cut from the cores at Ingrain's facility. Reports from Ingrain have undergone minor redaction to ensure privacy for the clients that processed the samples.

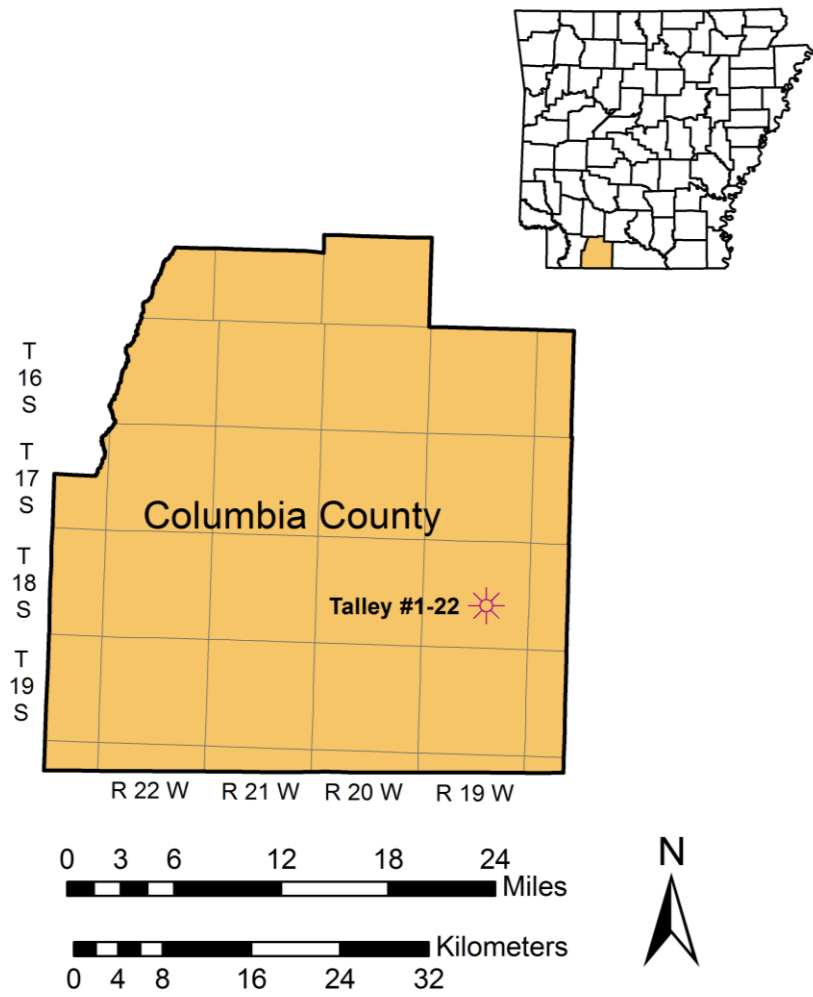


Figure 1. Well location map for Anadarko Talley #1-22.

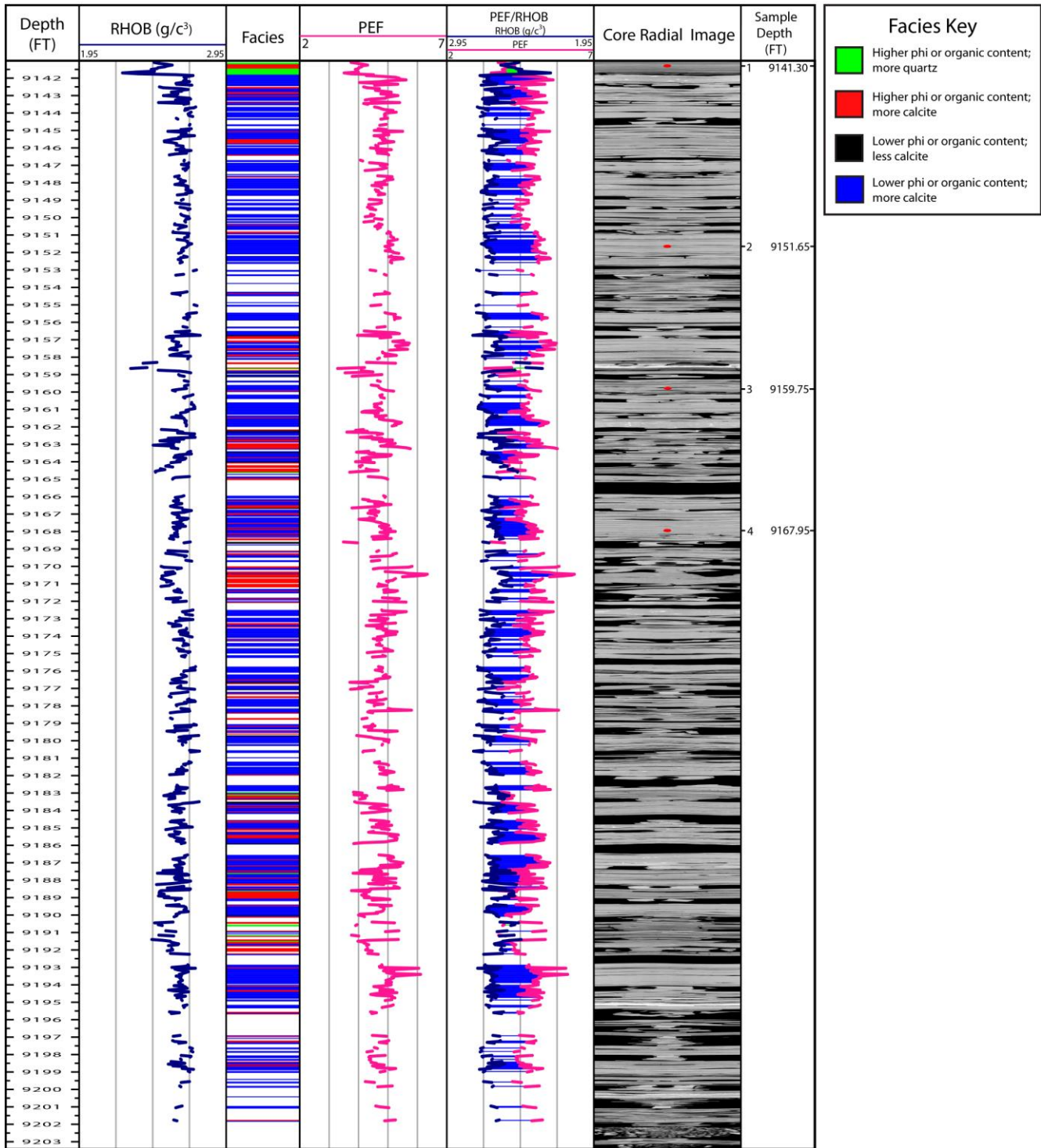


Figure 2. Locations of plug samples with bulk density (RHOB) and photoelectric factor (PEF) curves. Plug sample locations denoted with red dots.

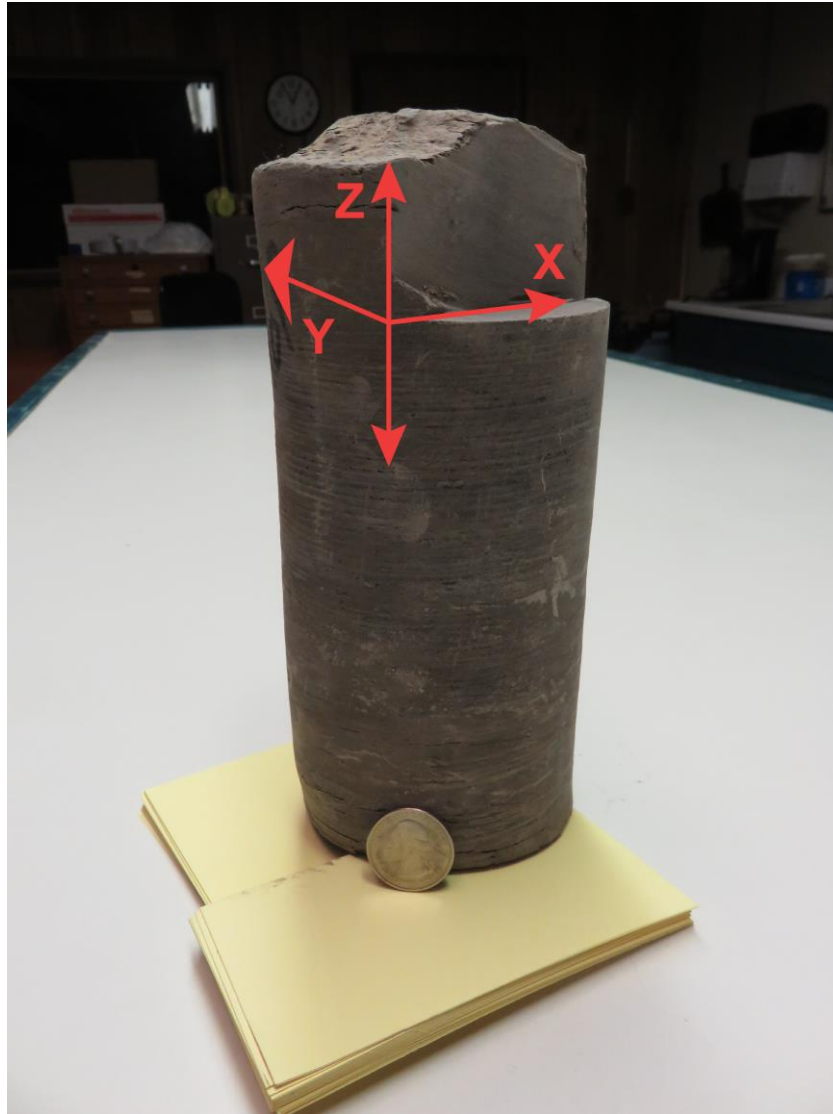


Figure 3. Core photograph with axes. Laminations are oriented approximately horizontal parallel to the X-axis. The Z-axis is parallel to the vertical axis of the well and the Y-axis is normal to the XY plane. Flat surface on side is where the plug sample was cut.

References

Imlay, R.W., 1949, Lower Cretaceous and Jurassic Formations of southern Arkansas: Arkansas

Geological Commission Information Circular 12, 64 p.

Vestal, J.H., 1950, Petroleum geology of the Smackover Formation of southern Arkansas: Arkansas

Geological Commission Information Circular 14, 19 p.

Weeks, W.B., 1938, South Arkansas stratigraphy with emphasis on the older coastal plain beds:

American Association of Petroleum Geologists Bulletin, v. 22, no. 8, p. 953-983.

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Plug Scale & 2D SEM Analysis

Tally #1-22

Columbia County, Arkansas

**Brown Dense Unit of Smackover Formation
(9141.30 ft. – 9167.95 ft.)**

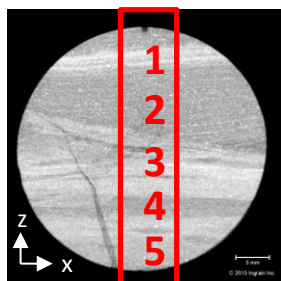
For

Arkansas Geological Survey

DATA AND RESULTS – Examples and Explanations

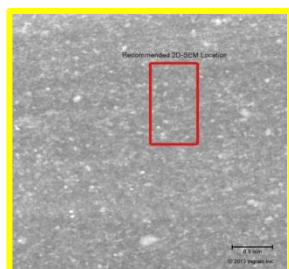


White Light Photo of Sample



2D grayscale X-ray projection/mosaic:

The X-ray projection image presented was obtained from a Micro-CT scanner. White shades typically represents high density, or higher PEF material (e.g. pyrite), Gray: minerals with densities of 2/3 g/cc, Black: fractures, organic material, or pore space. The scan resolution is indicated on individual sample pages. The red box represents a location where higher resolution CT projections were acquired at 4 microns/pixel. The numbers represent XRF location points that are reported in the table at the bottom of the page.

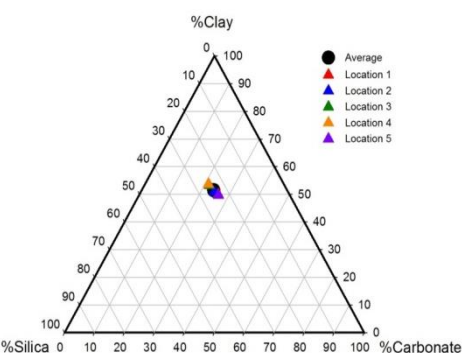


X-ray projection:

X-ray projection image at approximately 4 microns per pixel. Red box insert shows Ingrain selected locations for next stage of analysis, high resolution 2D scanning electron microscope (SEM) imaging.

X-ray Fluorescence (XRF) Ternary Diagram:

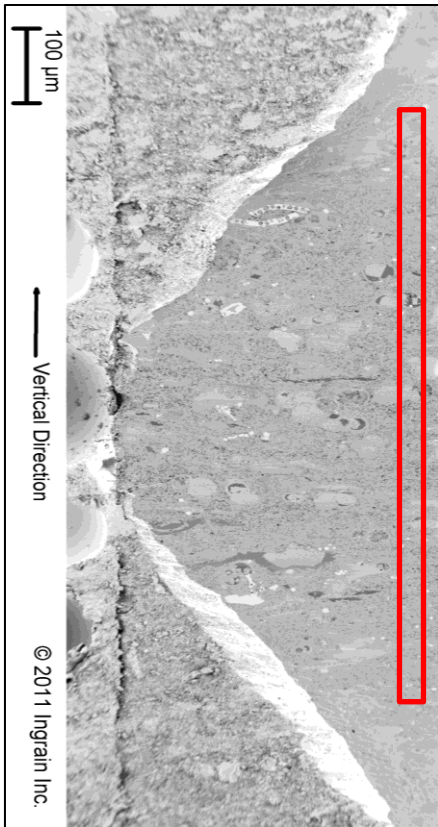
XRF weight percent of major elements plus trace elements thorium and uranium have been determined at approximately the numbered locations shown by red boxes in the above X-ray image. The data has been calibrated for shale samples. Weight percent of elements in other rock types may be less accurate. The elemental abundances have been converted to an approximate weight percent of silica, clay, and carbonate and are shown in the ternary diagram.



X-ray Fluorescence (XRF) Table:

The elemental abundances have been converted to an approximate weight percent of silica, clay, and carbonate and are shown listed in the table. Elemental percentages are reported in the attached well summary file.

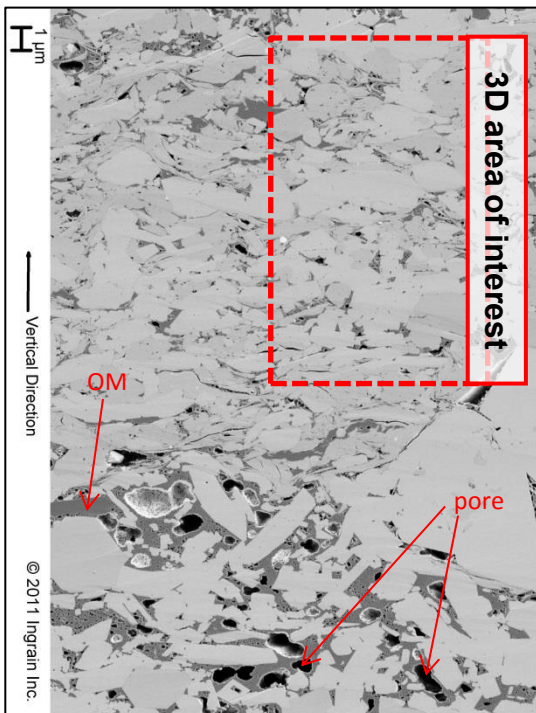
Location	Mineralogy by weight percentage		
	Silica	Clay	Carbonate
Location 1			
Location 2			
Location 3			
Location 4			
Location 5			
Average			



2D SEM Overview:

Once an area of interest is selected from the Micro-CT analysis, an area that is approximately 1 millimeter by 500 microns is polished. A 2D SEM overview image is taken with a field of view of approximately 750 microns. The overview shows laminations and heterogeneities at a larger scale.

The red box within the overview indicates where the smaller field of view 2D SEM images are acquired.



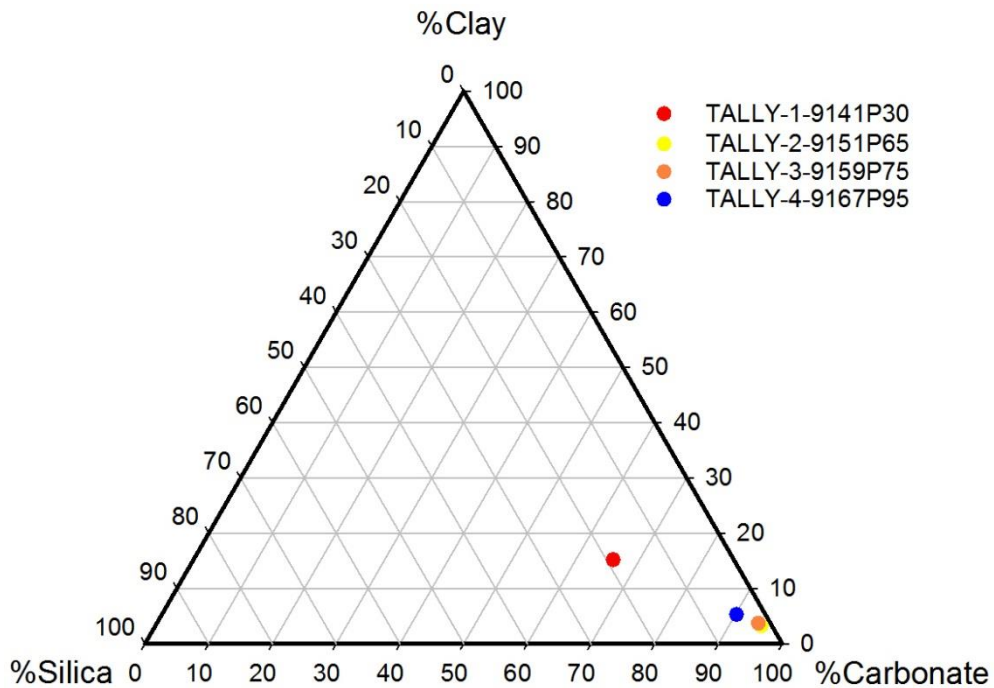
2D SEM Individual Images:

20 to 25 images are initially acquired from the highlighted area in the overview. Ten are segmented for porosity, organic matter, porosity in the organic matter, and high density materials. Images are taken at 15nm/pixel. A cross plot and data table are included to show the quantitative results. The red dashed box indicated the area of interest for 3D FIB-SEM analysis.

Interpretation of the 2D SEM Image:

White: High density material (e.g.: iron rich)
 Light Grey: Minerals with densities 2-3 g/cc
 Dark Grey: Organic Matter (OM)
 Black: Pore space

Summary of Average XRF Data – Tally #1-22

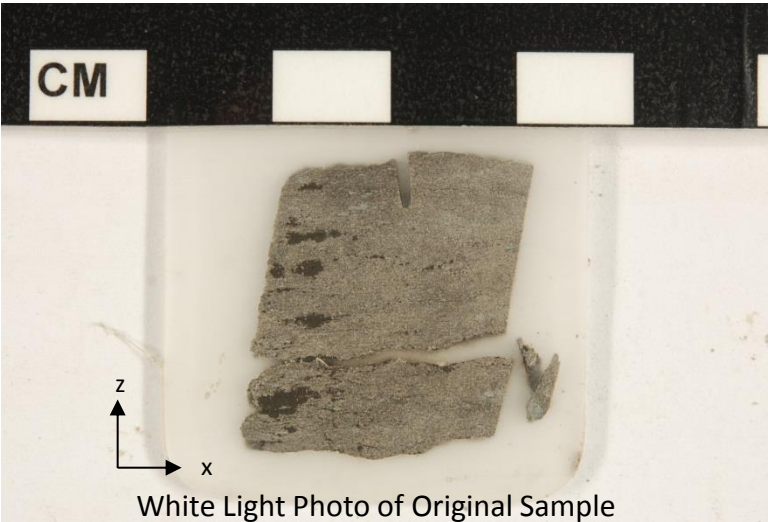


			Average mineralogy by weight percentage		
Sample	Depth (ft.)	Bulk Density (g/cm ³)	Silica	Clay	Carbonate
1	9141.30	2.53	19	15	66
2	9151.65	2.68	2	3	95
3	9159.75	2.70	2	4	94
4	9167.95	2.67	5	5	90

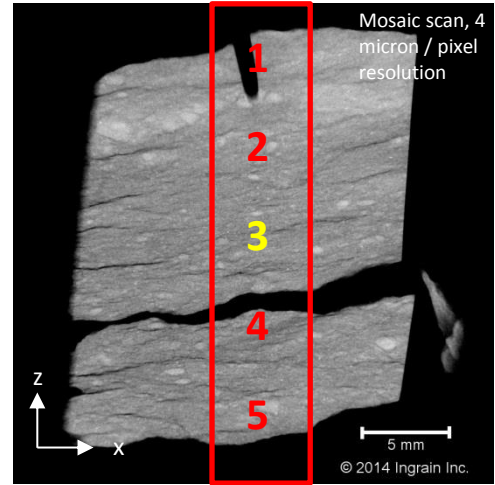
Summary of Results – 2D SEM

Sample #	Depth (ft.)	Average Porosity (%)	Average Organic Matter (%)	Average Porosity in Organic Matter (%)	Average High Density Material (%)
1	9141.30	2.9	3.4	0.5	1.5
2	9151.65	0.3	0.1	0.1	0.1
3	9159.75	0.4	0.2	0.0	0.0
4	9167.95	1.3	1.3	0.3	0.2

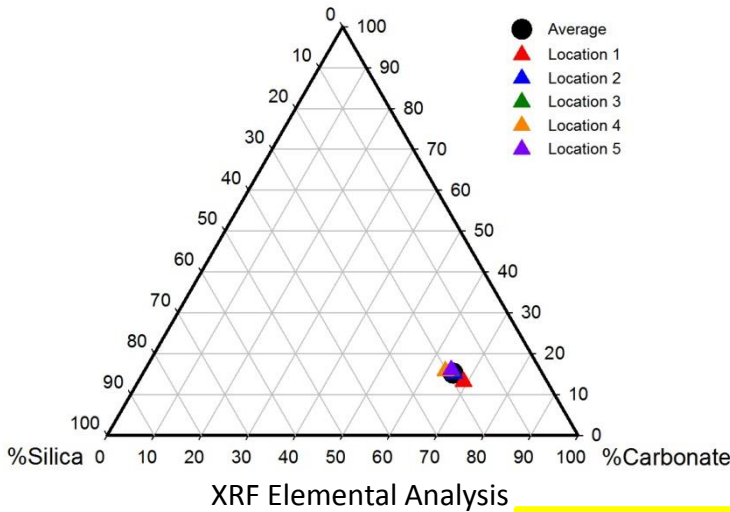
Micro-XCT Imaging and SEM Sample Selection



White Light Photo of Original Sample

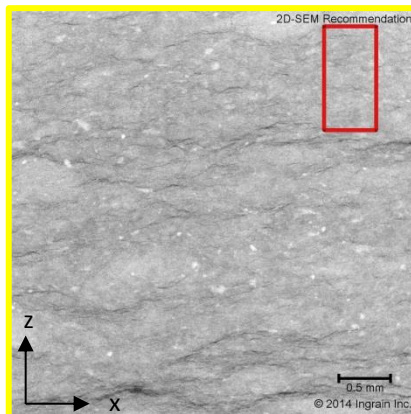


XCT Image Resolution - 14 μm per pixel



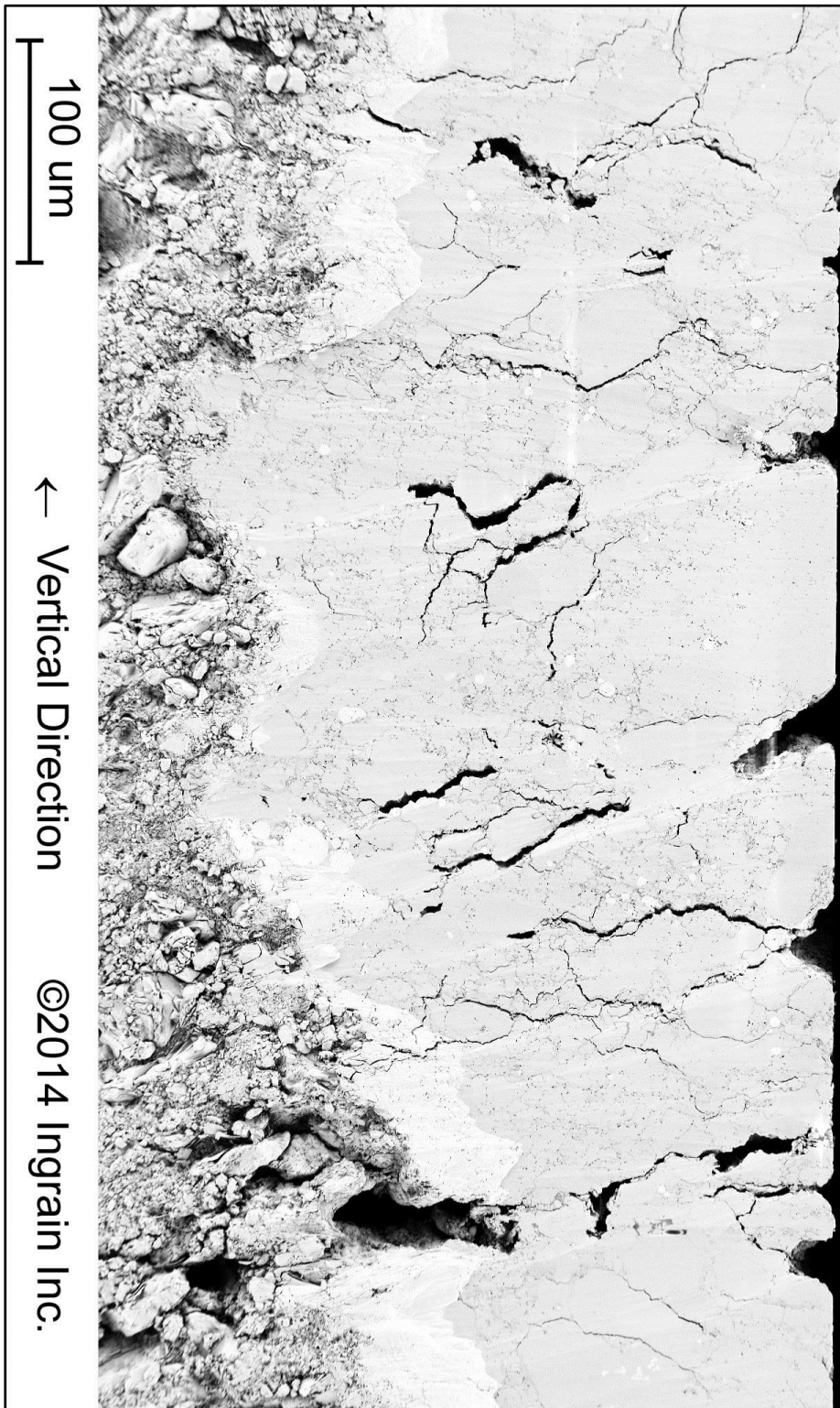
XRF Elemental Analysis

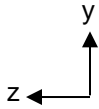
	Mineralogy by weight percentage		
Location	Silica	Clay	Carbonate
Location 1	18	13	69
Location 2	19	15	66
Location 3	19	16	65
Location 4	20	16	64
Location 5	19	16	65
Average	19	15	66



XCT Image Resolution - 4 μm per pixel
Location #3 - Selection for 2D-SEM

2D SEM Overview



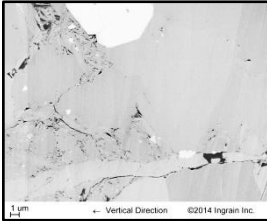


2D SEM Images @ 15 nm per pixel

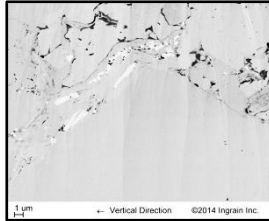
2D01



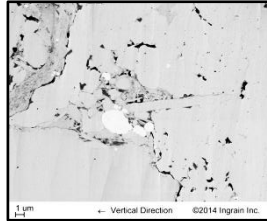
2D02



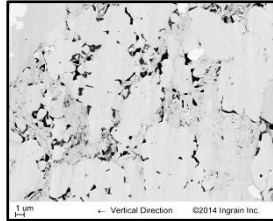
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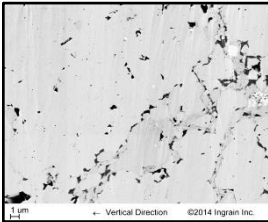
2D04



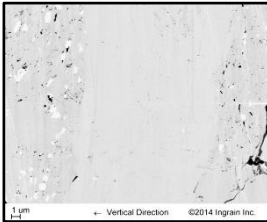
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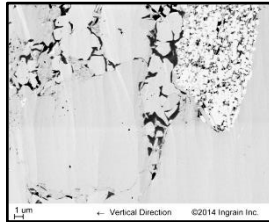
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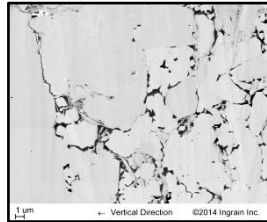
2D08



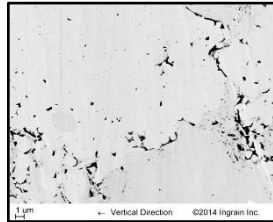
2D09



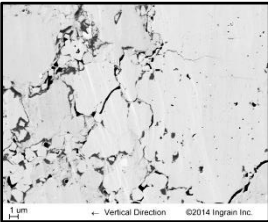
2D10



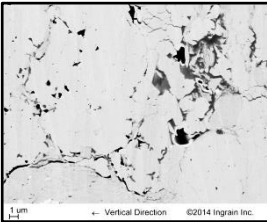
2D11



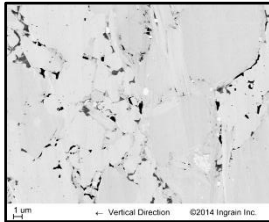
2D12



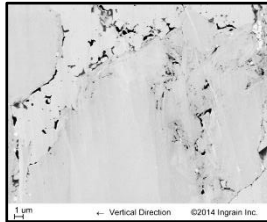
2D13



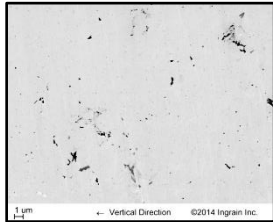
2D17



2D18

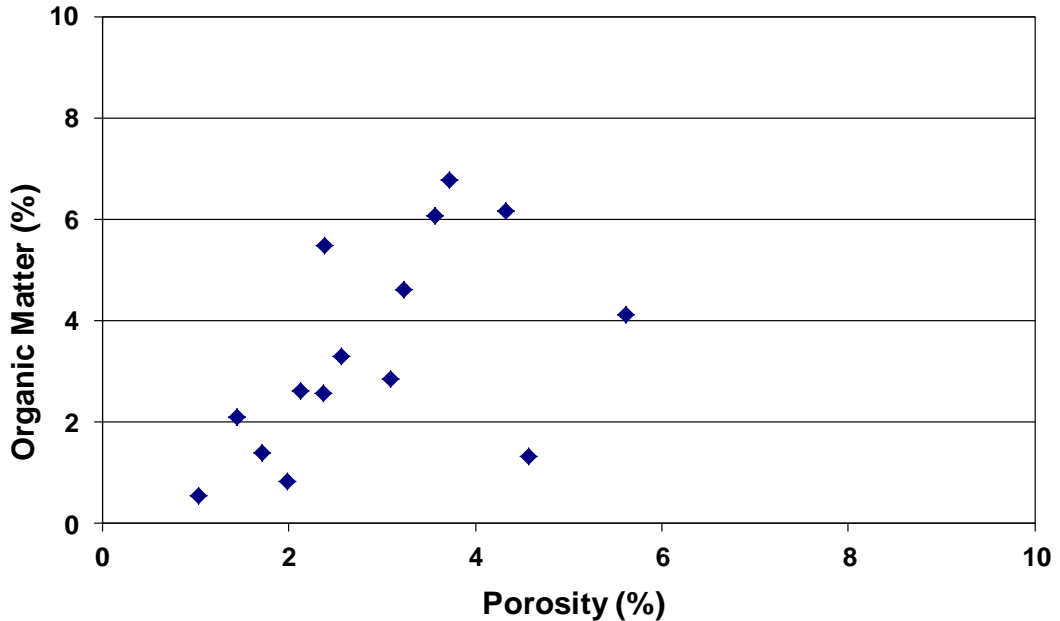


2D20



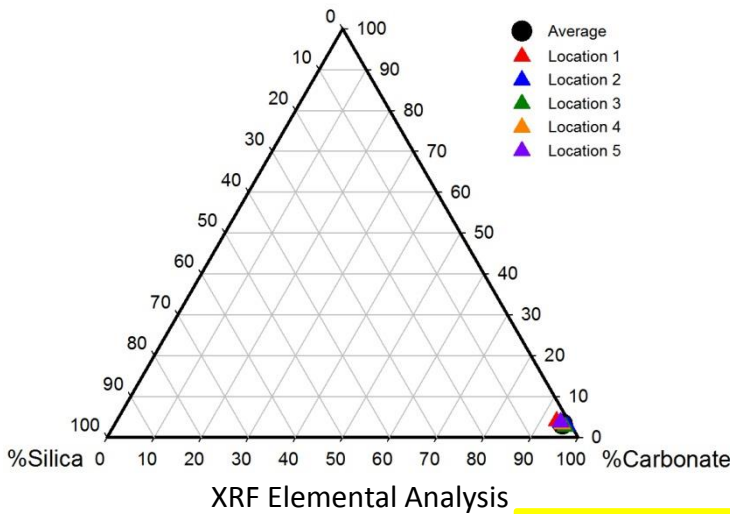
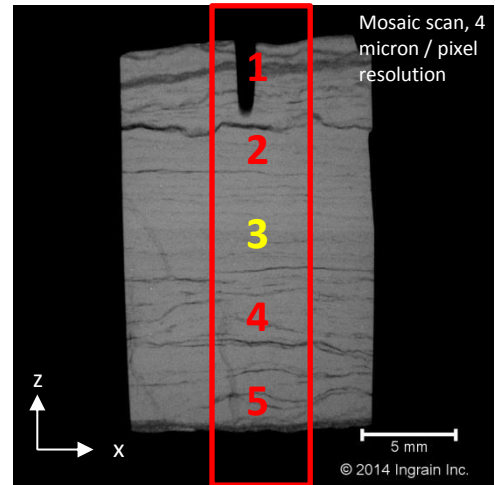
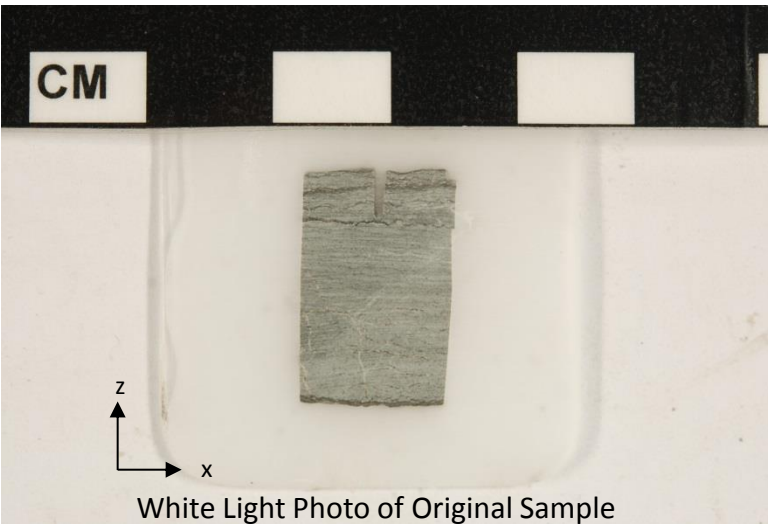
2D SEM Number	Porosity (%)	Organic Matter (%)	Porosity in Organic Matter (%)	High Density (%)
2D01	3.2	4.6	0.8	0.7
2D02	1.7	1.4	0.2	5.6
2D03	1.5	2.1	0.2	1.8
2D04	2.6	3.3	0.5	1.6
2D05	5.6	4.1	1.1	0.5
2D07	3.1	2.9	0.3	0.4
2D08	2.0	0.8	0.1	1.7
2D09	3.6	6.1	0.7	9.5
2D10	2.4	5.5	0.3	0.2
2D11	4.6	1.3	0.8	0.0
2D12	4.3	6.2	0.6	0.1
2D13	3.7	6.8	0.6	0.1
2D17	2.1	2.6	0.3	0.2
2D18	2.4	2.6	0.4	0.4
2D20	1.0	0.6	0.0	0.0

2D SEM Summary

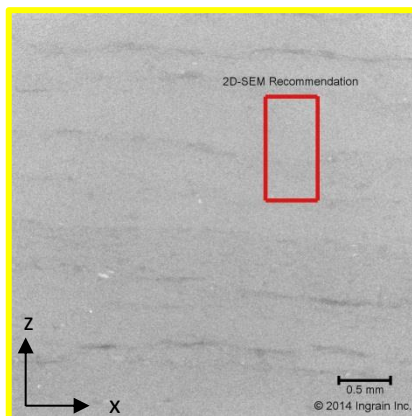


2D SEM Number	Porosity (%)	Organic Matter (%)	Porosity in Organic Matter (%)	High Density (%)
2D01	3.2	4.6	0.8	0.7
2D02	1.7	1.4	0.2	5.6
2D03	1.5	2.1	0.2	1.8
2D04	2.6	3.3	0.5	1.6
2D05	5.6	4.1	1.1	0.5
2D07	3.1	2.9	0.3	0.4
2D08	2.0	0.8	0.1	1.7
2D09	3.6	6.1	0.7	9.5
2D10	2.4	5.5	0.3	0.2
2D11	4.6	1.3	0.8	0.0
2D12	4.3	6.2	0.6	0.1
2D13	3.7	6.8	0.6	0.1
2D17	2.1	2.6	0.3	0.2
2D18	2.4	2.6	0.4	0.4
2D20	1.0	0.6	0.0	0.0

Micro-XCT Imaging and SEM Sample Selection



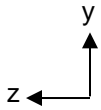
Location	Mineralogy by weight percentage		
	Silica	Clay	Carbonate
Location 1	3	4	93
Location 2	1	3	96
Location 3	1	3	96
Location 4	2	3	95
Location 5	2	4	94
Average	2	3	95



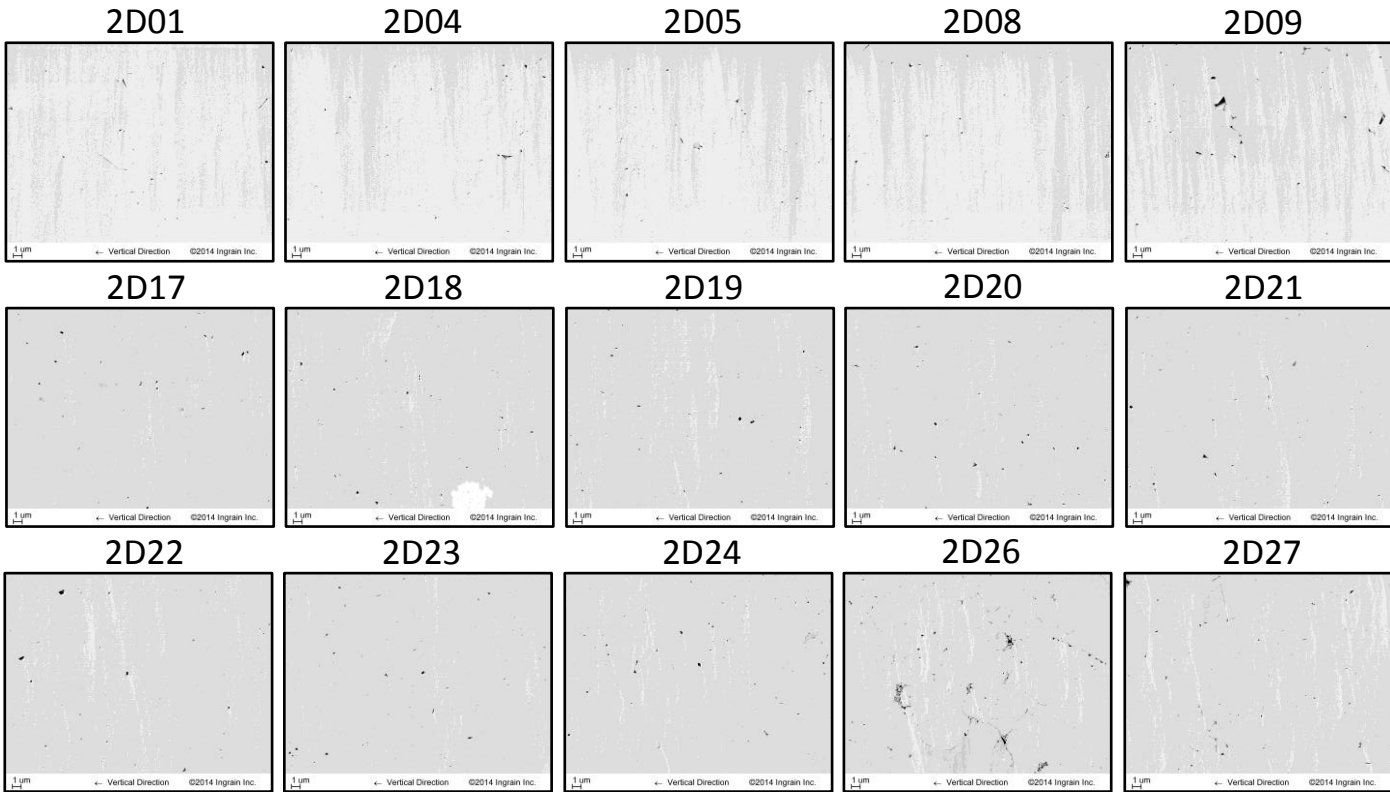
Location #3 - Selection for 2D-SEM

2D SEM Overview



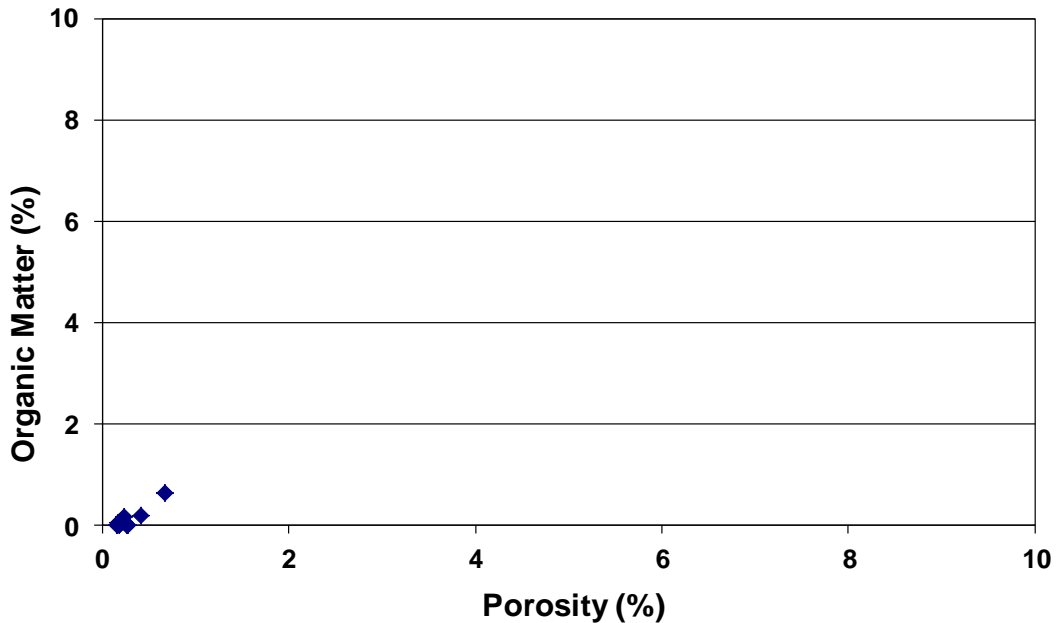


2D SEM Images @ 15 nm per pixel



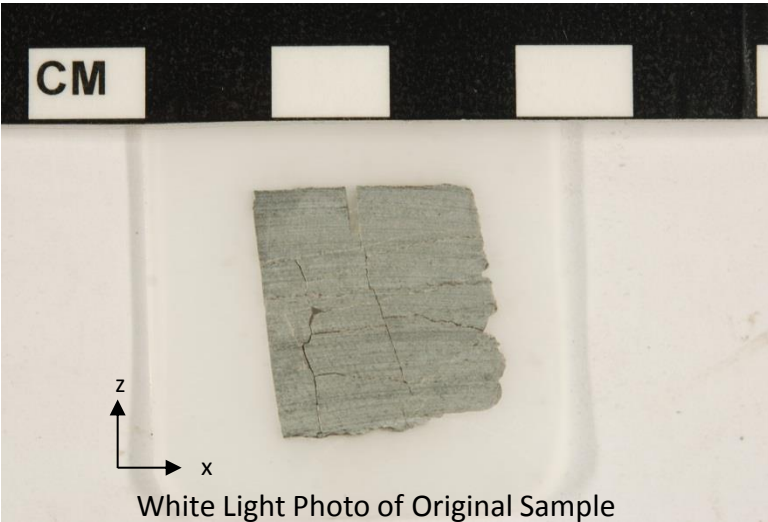
2D SEM Number	Porosity (%)	Organic Matter (%)	Porosity in Organic Matter (%)	High Density (%)
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2D04	0.3	0.0	0.0	0.0
2D05	0.3	0.0	0.0	0.0
2D08	0.2	0.0	0.0	0.0
2D09	0.4	0.2	0.2	0.0
2D17	0.2	0.0	0.1	0.0
2D18	0.2	0.0	0.1	1.5
2D19	0.2	0.0	0.1	0.0
2D20	0.3	0.0	0.1	0.0
2D21	0.2	0.1	0.1	0.0
2D22	0.2	0.0	0.1	0.0
2D23	0.2	0.1	0.1	0.0
2D24	0.2	0.1	0.1	0.0
2D26	0.7	0.6	0.5	0.0
2D27	0.2	0.2	0.1	0.0

2D SEM Summary

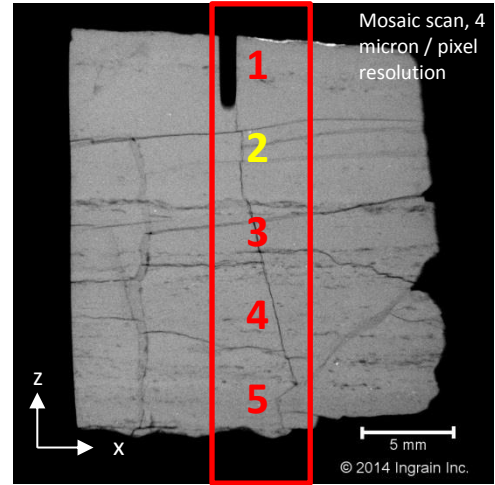


2D SEM Number	Porosity (%)	Organic Matter (%)	Porosity in Organic Matter (%)	High Density (%)
2D01	0.2	0.0	0.0	0.0
2D04	0.3	0.0	0.0	0.0
2D05	0.3	0.0	0.0	0.0
2D08	0.2	0.0	0.0	0.0
2D09	0.4	0.2	0.2	0.0
2D17	0.2	0.0	0.1	0.0
2D18	0.2	0.0	0.1	1.5
2D19	0.2	0.0	0.1	0.0
2D20	0.3	0.0	0.1	0.0
2D21	0.2	0.1	0.1	0.0
2D22	0.2	0.0	0.1	0.0
2D23	0.2	0.1	0.1	0.0
2D24	0.2	0.1	0.1	0.0
2D26	0.7	0.6	0.5	0.0
2D27	0.2	0.2	0.1	0.0

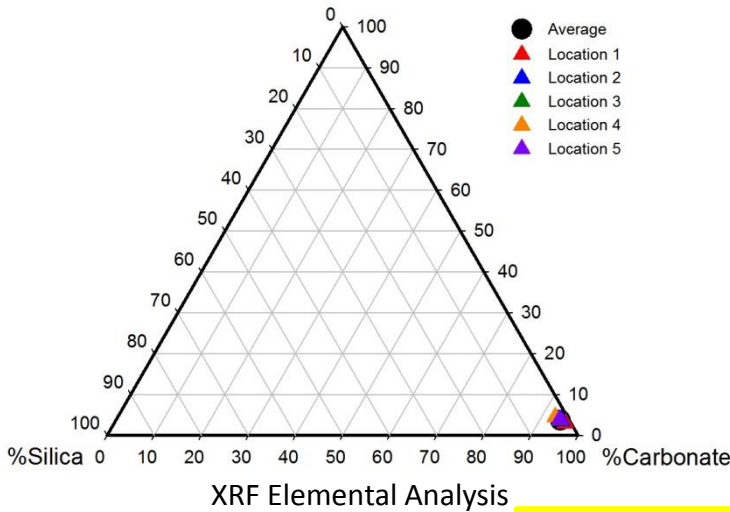
Micro-XCT Imaging and SEM Sample Selection



White Light Photo of Original Sample

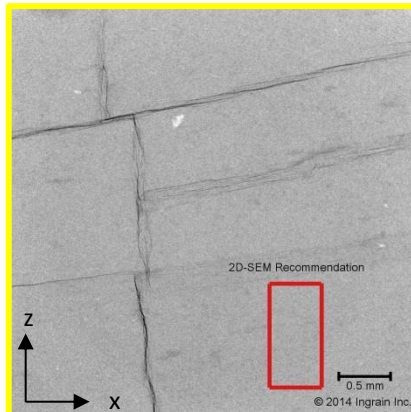


XCT Image Resolution - 14 μm per pixel



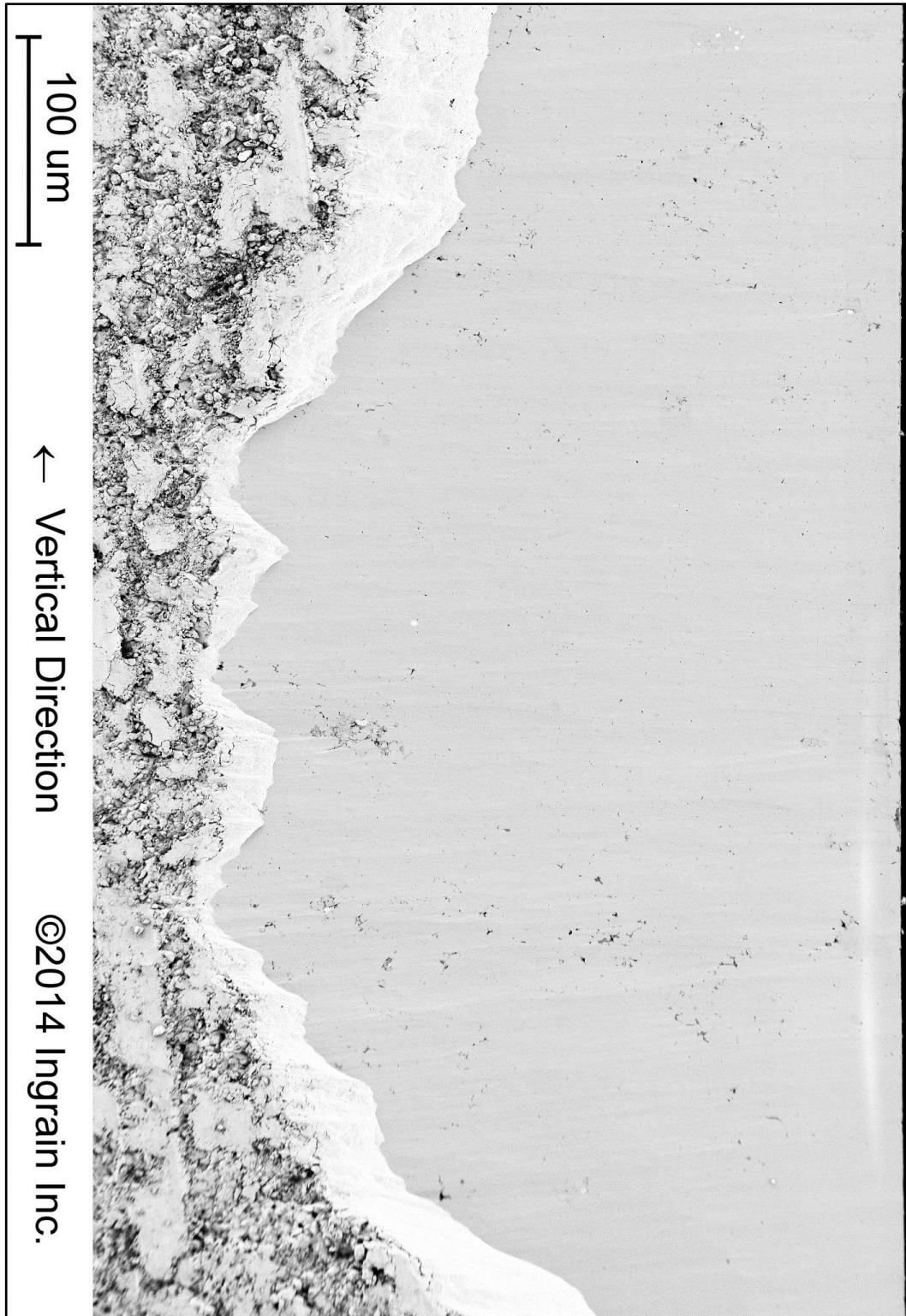
XRF Elemental Analysis

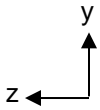
Mineralogy by weight percentage			
Location	Silica	Clay	Carbonate
Location 1	1	3	96
Location 2	2	3	95
Location 3	2	4	94
Location 4	3	4	93
Location 5	2	4	94
Average	2	4	94



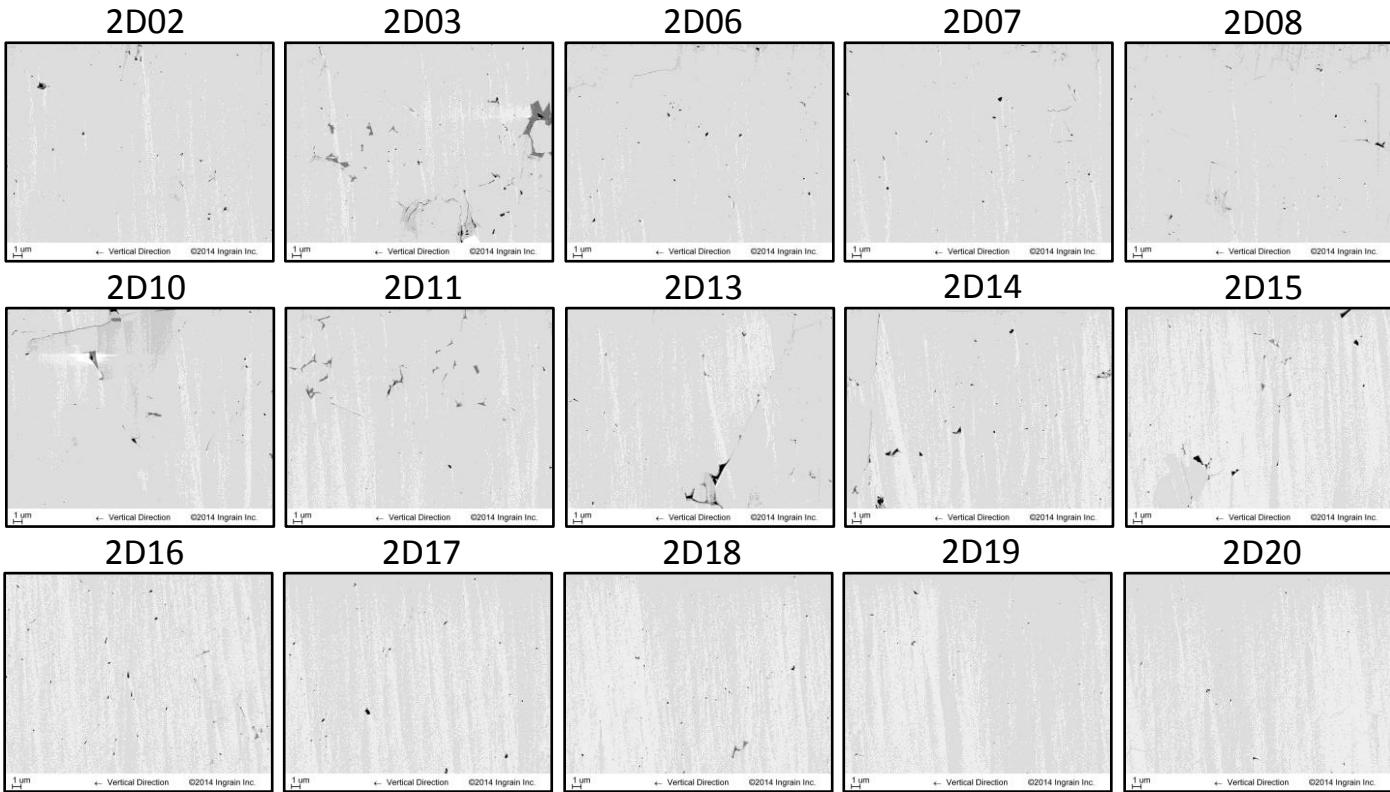
XCT Image Resolution - 4 μm per pixel
Location #2 - Selection for 2D-SEM

2D SEM Overview



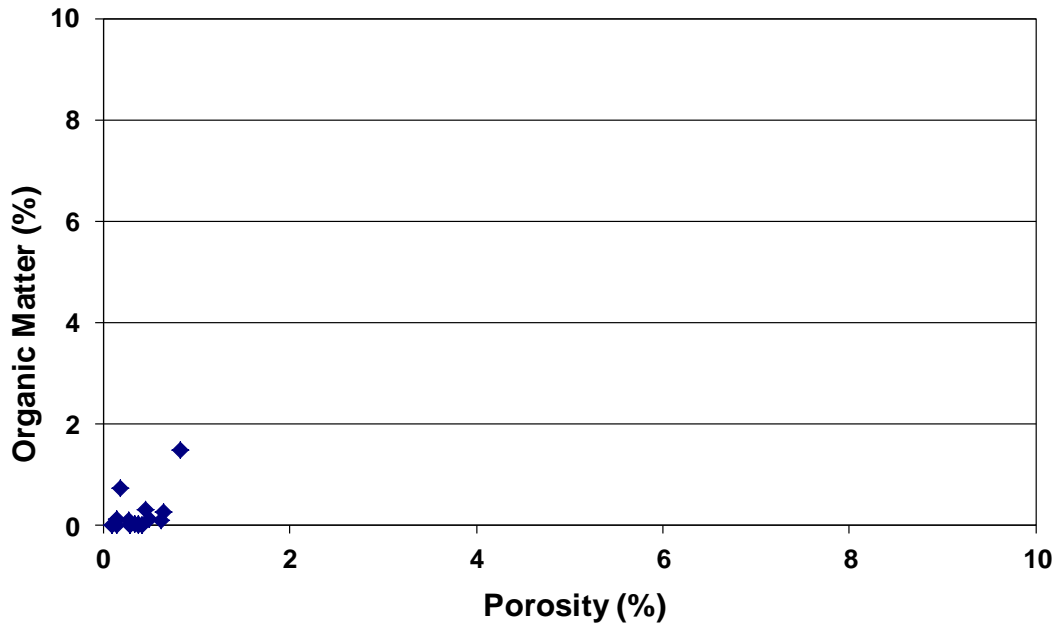


2D SEM Images @ 15 nm per pixel



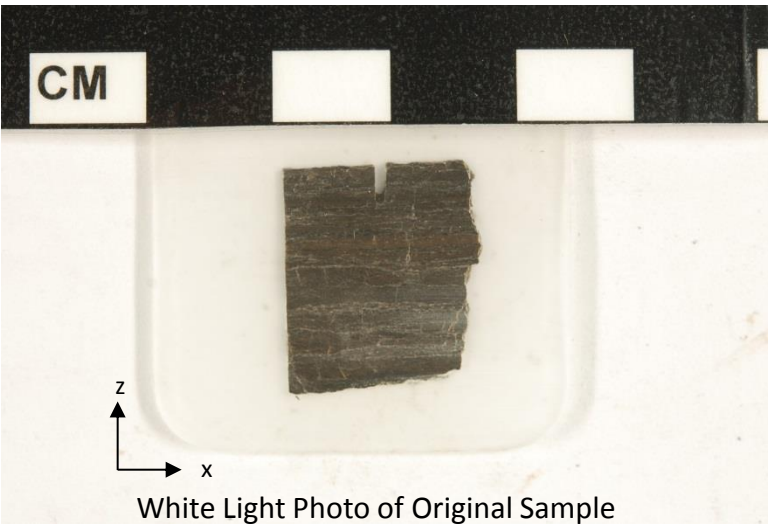
2D SEM Number	Porosity (%)	Organic Matter (%)	Porosity in Organic Matter (%)	High Density (%)
2D02	0.3	0.0	0.0	0.0
2D03	0.8	1.5	0.1	0.2
2D06	0.4	0.0	0.0	0.0
2D07	0.4	0.0	0.0	0.0
2D08	0.4	0.0	0.0	0.0
2D10	0.5	0.3	0.0	0.0
2D11	0.2	0.7	0.0	0.0
2D13	0.7	0.3	0.1	0.0
2D14	0.6	0.1	0.0	0.0
2D15	0.5	0.1	0.0	0.0
2D16	0.3	0.1	0.0	0.0
2D17	0.3	0.0	0.0	0.0
2D18	0.2	0.1	0.0	0.0
2D19	0.2	0.0	0.0	0.0
2D20	0.1	0.0	0.0	0.0

2D SEM Summary

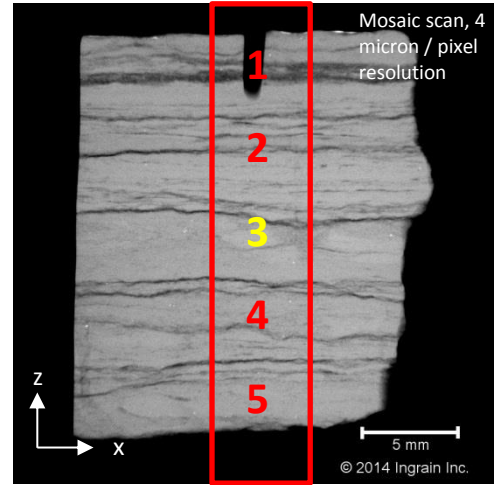


2D SEM Number	Porosity (%)	Organic Matter (%)	Porosity in Organic Matter (%)	High Density (%)
2D02	0.3	0.0	0.0	0.0
2D03	0.8	1.5	0.1	0.2
2D06	0.4	0.0	0.0	0.0
2D07	0.4	0.0	0.0	0.0
2D08	0.4	0.0	0.0	0.0
2D10	0.5	0.3	0.0	0.0
2D11	0.2	0.7	0.0	0.0
2D13	0.7	0.3	0.1	0.0
2D14	0.6	0.1	0.0	0.0
2D15	0.5	0.1	0.0	0.0
2D16	0.3	0.1	0.0	0.0
2D17	0.3	0.0	0.0	0.0
2D18	0.2	0.1	0.0	0.0
2D19	0.2	0.0	0.0	0.0
2D20	0.1	0.0	0.0	0.0

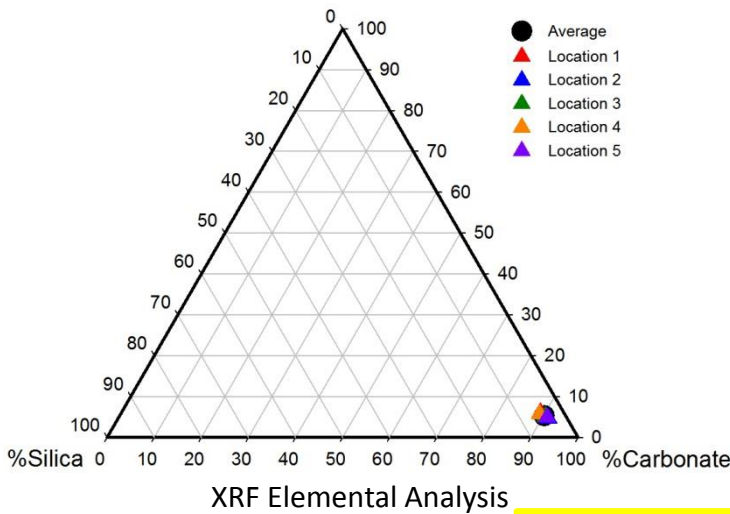
Micro-XCT Imaging and SEM Sample Selection



White Light Photo of Original Sample
%Clay

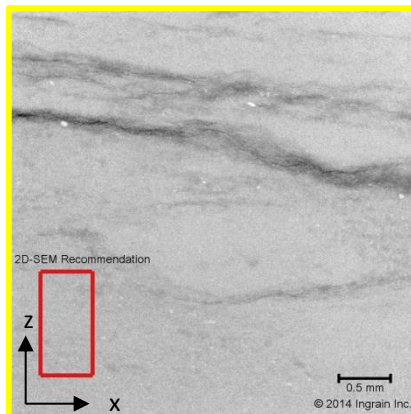


XCT Image Resolution - 14 µm per pixel



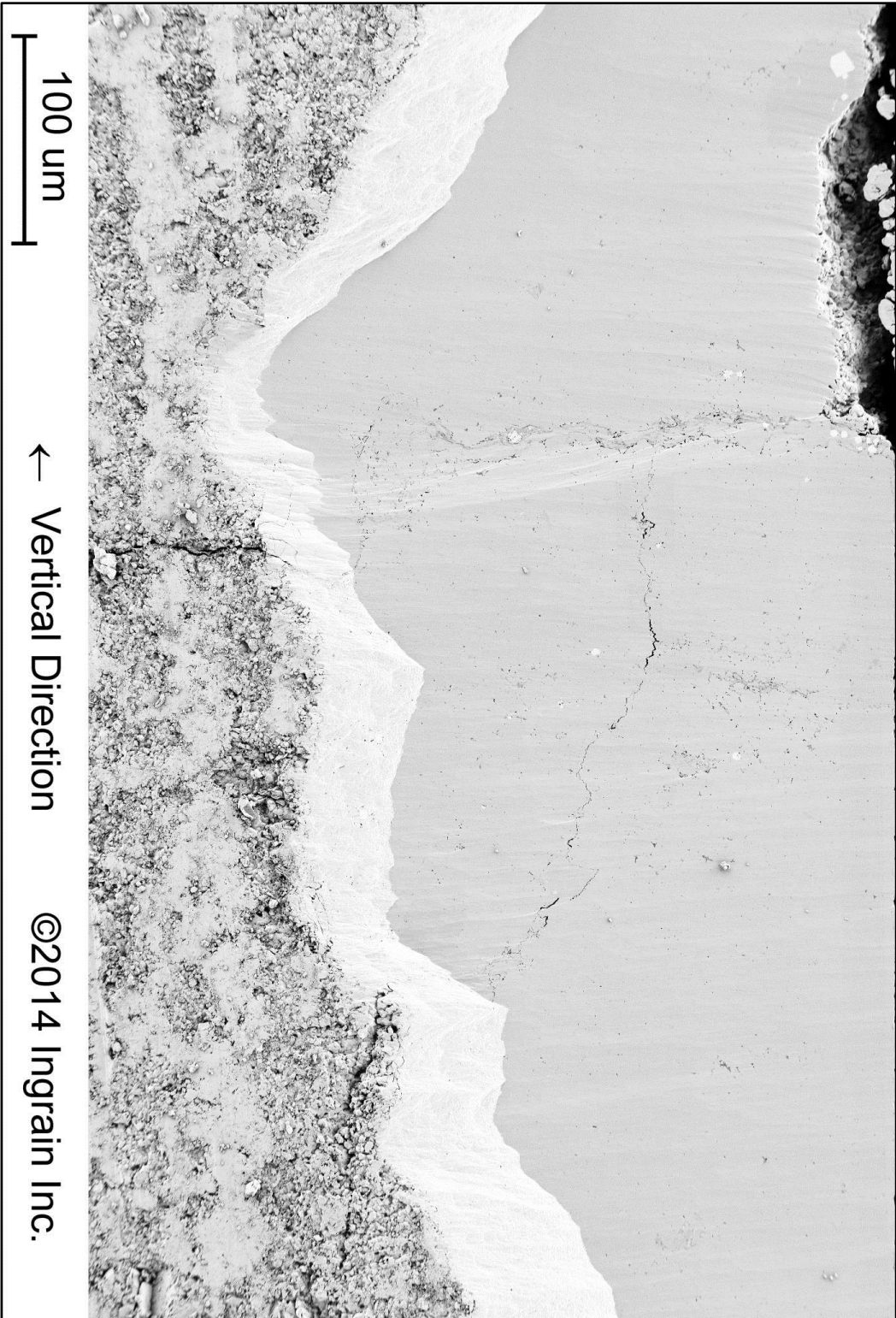
XRF Elemental Analysis

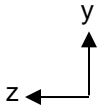
	Mineralogy by weight percentage		
Location	Silica	Clay	Carbonate
Location 1	5	6	89
Location 2	4	5	91
Location 3	4	5	90
Location 4	5	6	89
Location 5	4	5	91
Average	5	5	90



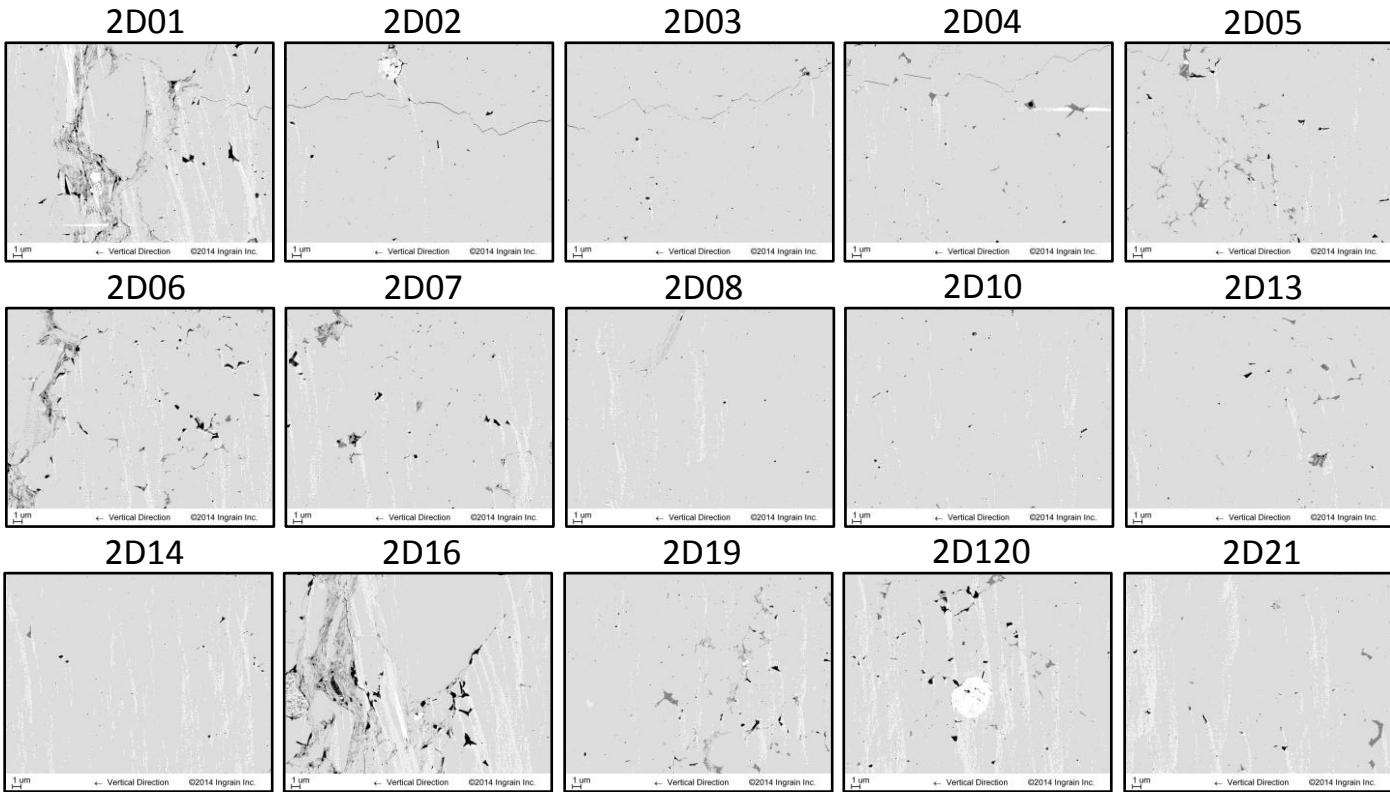
XCT Image Resolution - 4 µm per pixel
Location #3 - Selection for 2D-SEM

2D SEM Overview



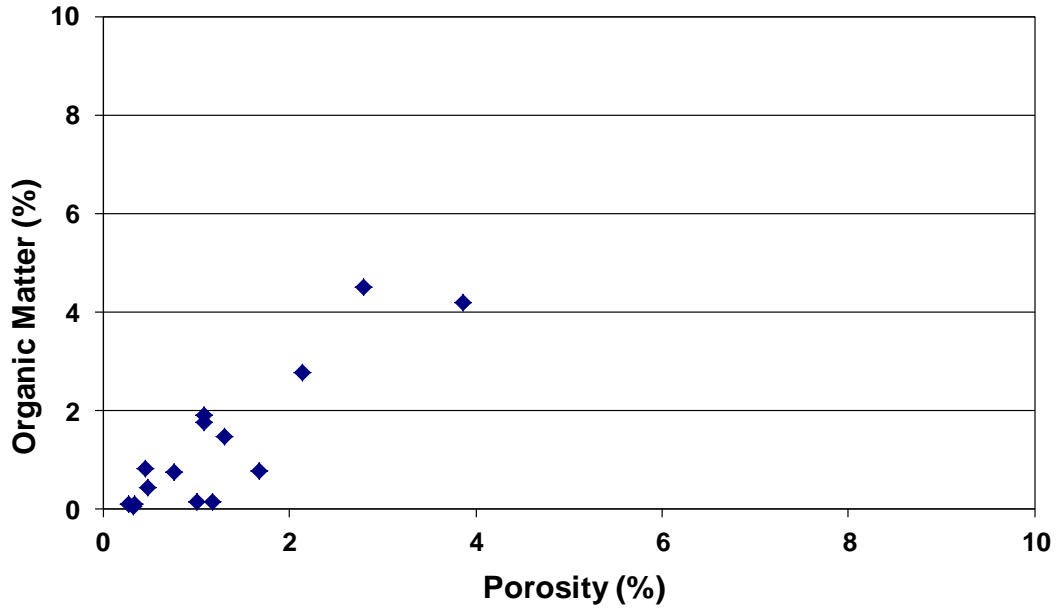


2D SEM Images @ 15 nm per pixel



2D SEM Number	Porosity (%)	Organic Matter (%)	Porosity in Organic Matter (%)	High Density (%)
2D01	2.8	4.5	1.2	0.3
2D02	1.2	0.1	0.1	0.7
2D03	1.0	0.2	0.1	0.0
2D04	0.8	0.8	0.1	0.0
2D05	1.1	1.9	0.2	0.0
2D06	2.1	2.8	0.4	0.1
2D07	1.3	1.5	0.3	0.0
2D08	0.3	0.1	0.0	0.0
2D10	0.3	0.1	0.0	0.0
2D13	0.5	0.8	0.1	0.0
2D14	0.3	0.1	0.0	0.0
2D16	3.9	4.2	1.6	0.1
2D19	1.1	1.8	0.2	0.1
2D20	1.7	0.8	0.2	2.3
2D21	0.5	0.4	0.1	0.0

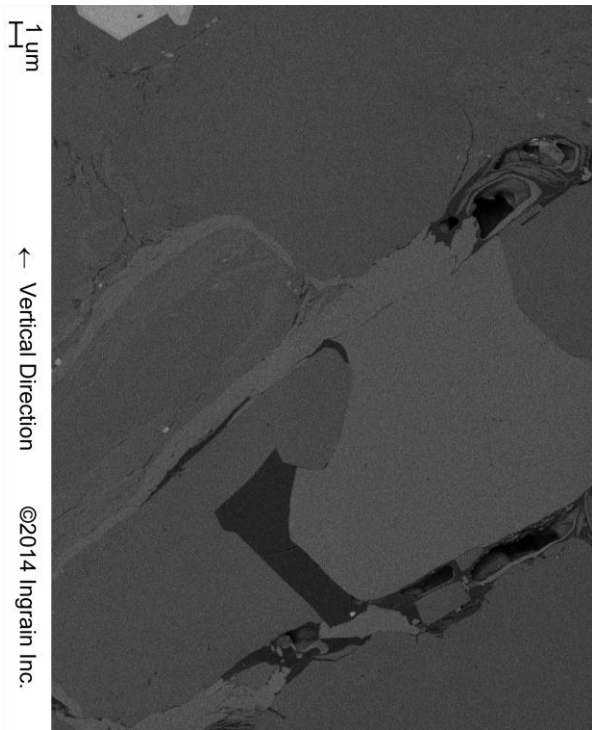
2D SEM Summary



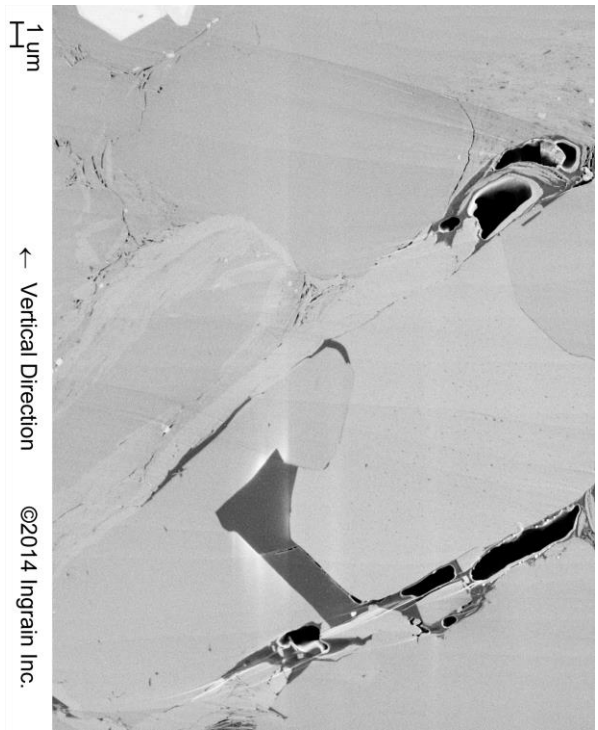
2D SEM Number	Porosity (%)	Organic Matter (%)	Porosity in Organic Matter (%)	High Density (%)
2D01	2.8	4.5	1.2	0.3
2D02	1.2	0.1	0.1	0.7
2D03	1.0	0.2	0.1	0.0
2D04	0.8	0.8	0.1	0.0
2D05	1.1	1.9	0.2	0.0
2D06	2.1	2.8	0.4	0.1
2D07	1.3	1.5	0.3	0.0
2D08	0.3	0.1	0.0	0.0
2D10	0.3	0.1	0.0	0.0
2D13	0.5	0.8	0.1	0.0
2D14	0.3	0.1	0.0	0.0
2D16	3.9	4.2	1.6	0.1
2D19	1.1	1.8	0.2	0.1
2D20	1.7	0.8	0.2	2.3
2D21	0.5	0.4	0.1	0.0

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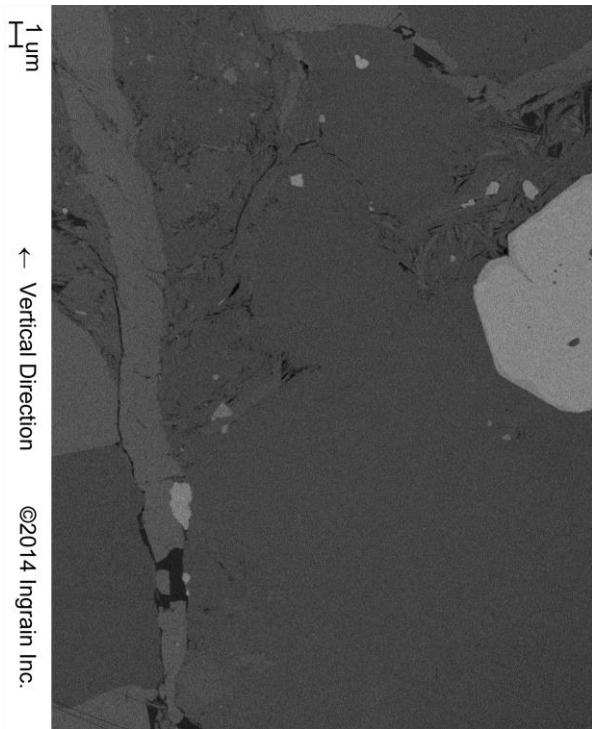
Appendix 1. 2D SEM Images, 15 Nanometers Per Pixel Resolution



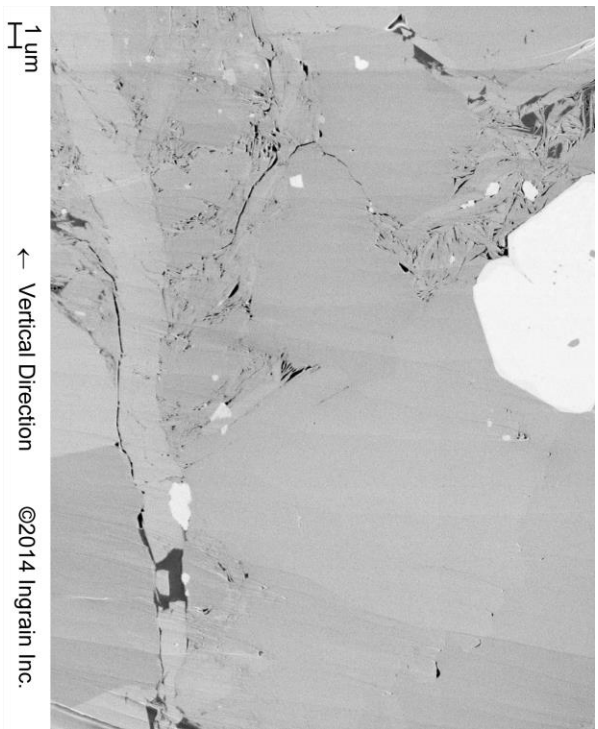
1a. 9141.30 ft., backscatter



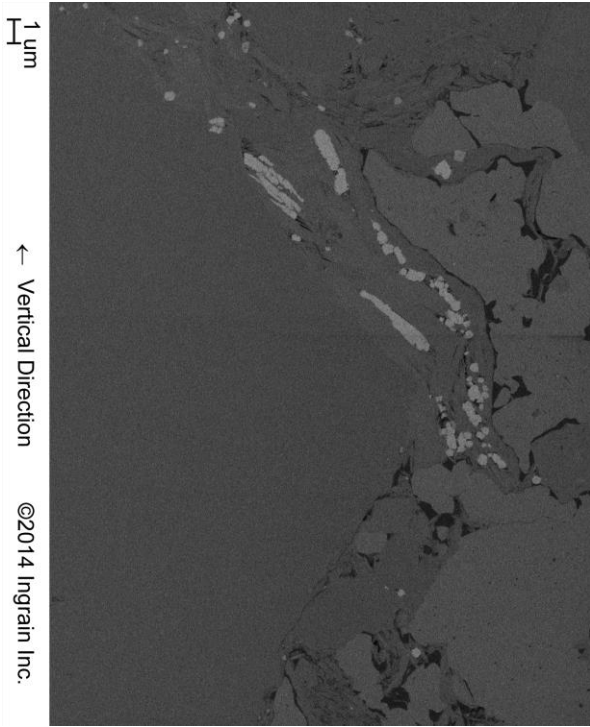
1b. 9141.30 ft., secondary



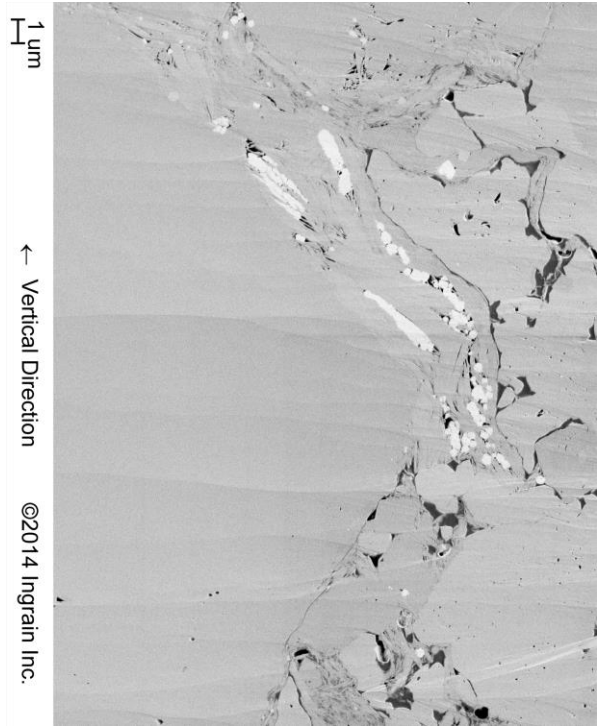
2a. 9141.30 ft., backscatter



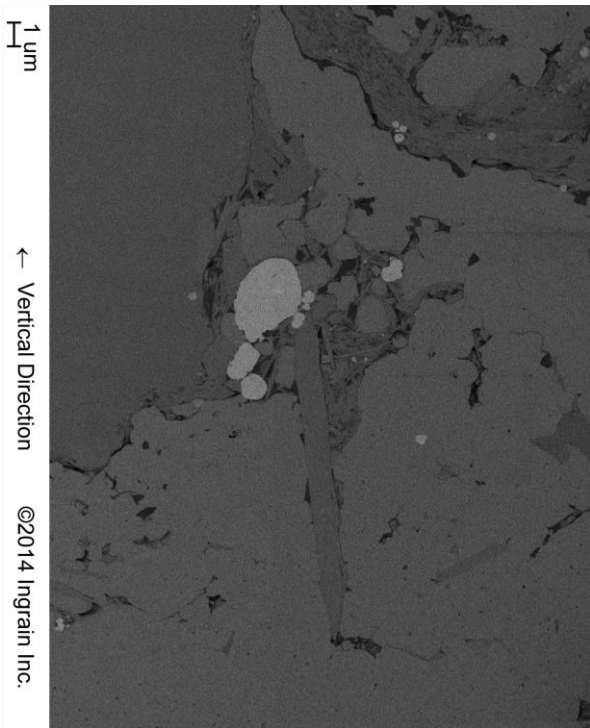
2b. 9141.30 ft., secondary



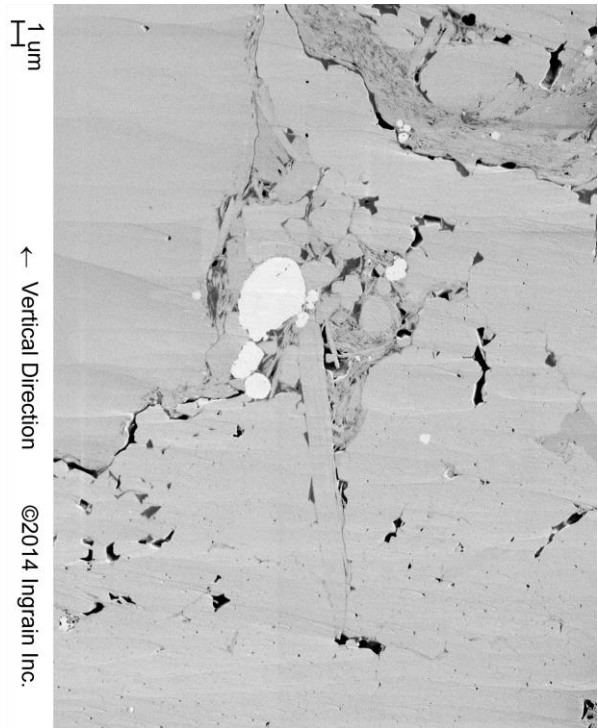
3a. 9141.30 ft., backscatter



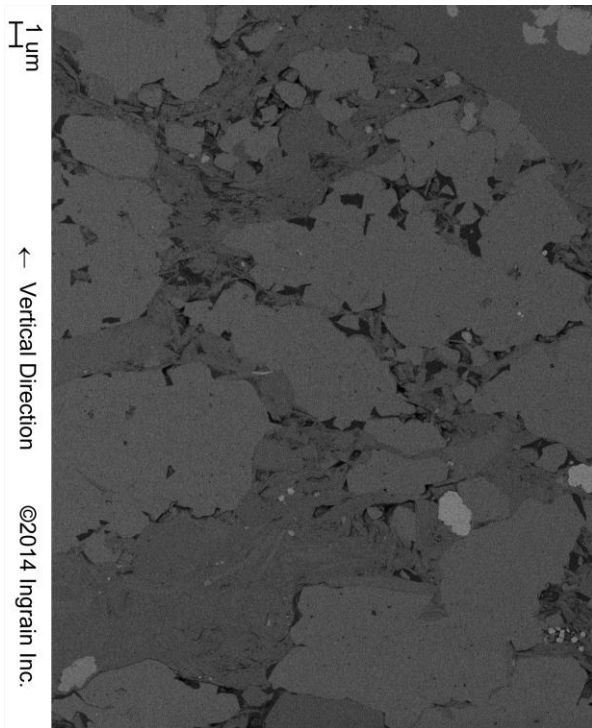
3b. 9141.30 ft., secondary



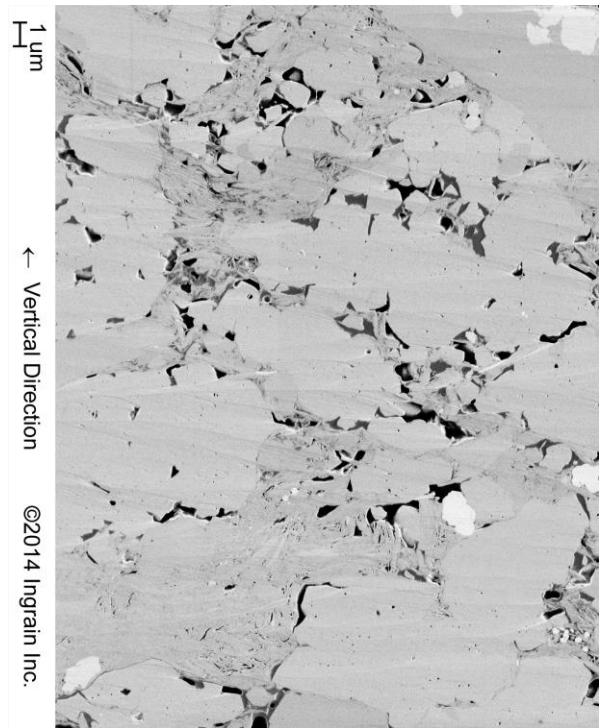
4a. 9141.30 ft., backscatter



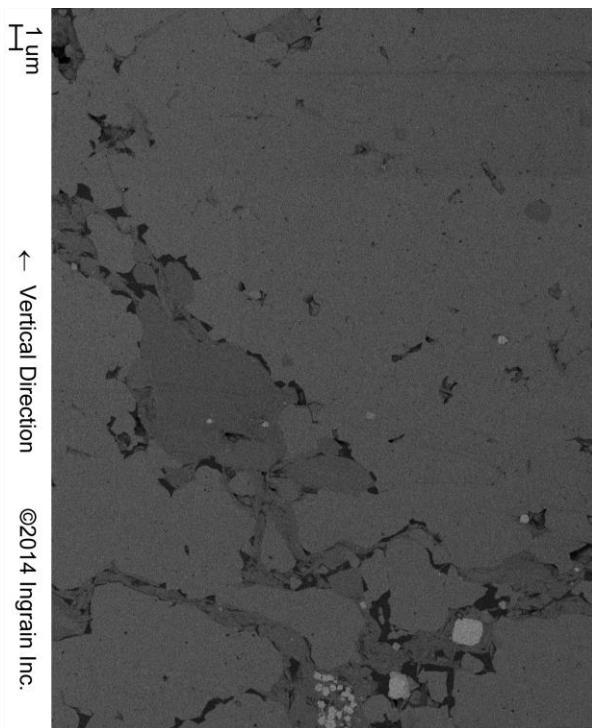
4b. 9141.30 ft., secondary



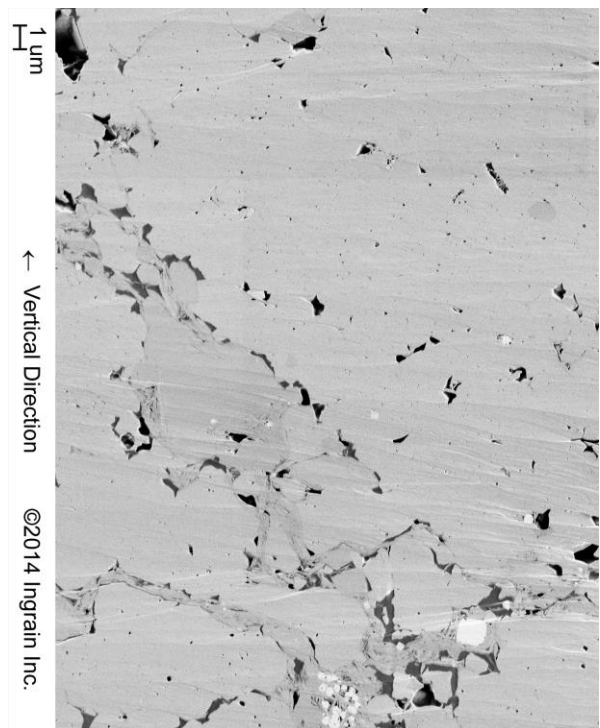
5a. 9141.30 ft., backscatter



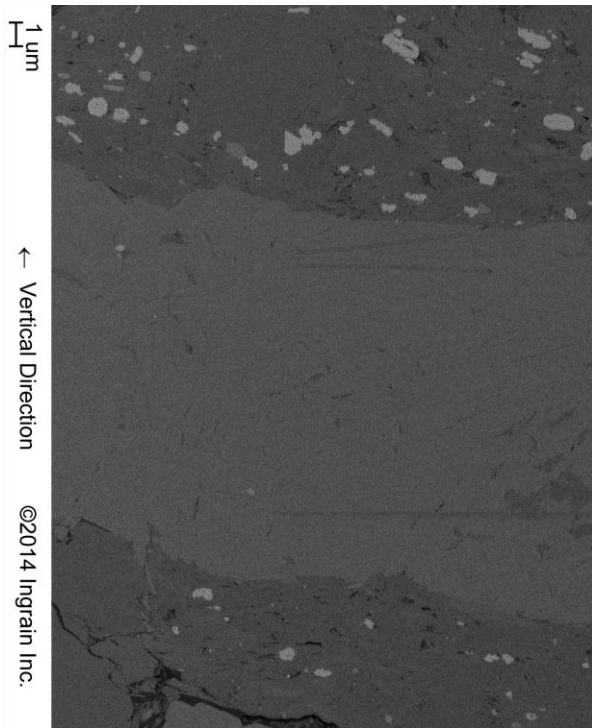
5b. 9141.30 ft., secondary



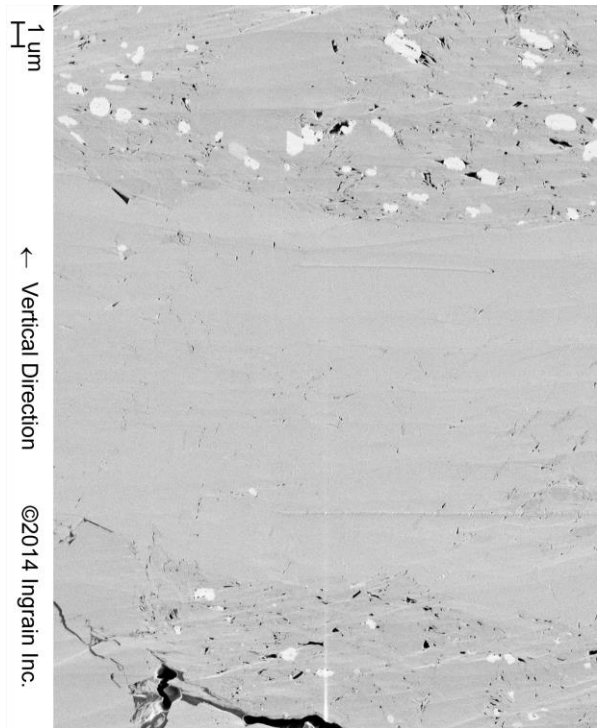
6a. 9141.30 ft., backscatter



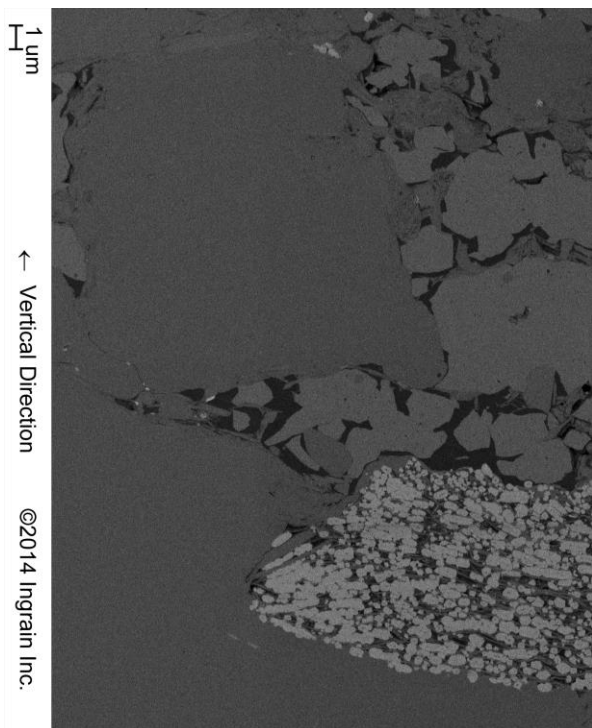
6b. 9141.30 ft., secondary



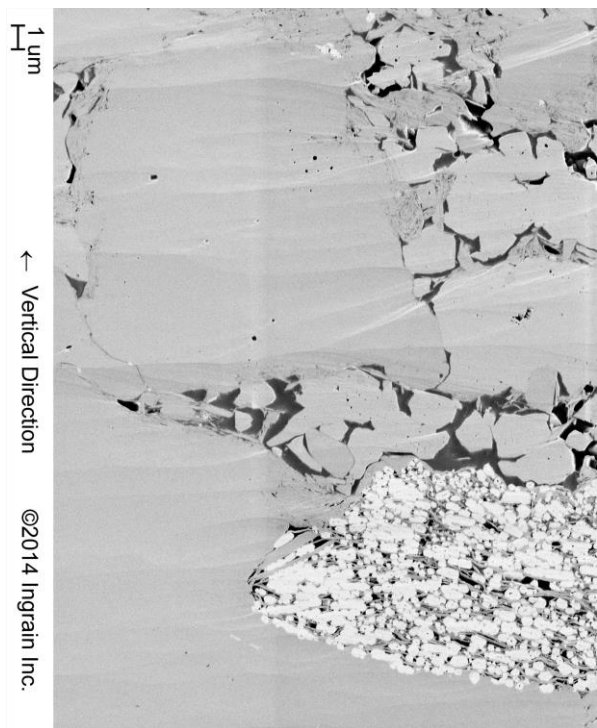
7a. 9141.30 ft., backscatter



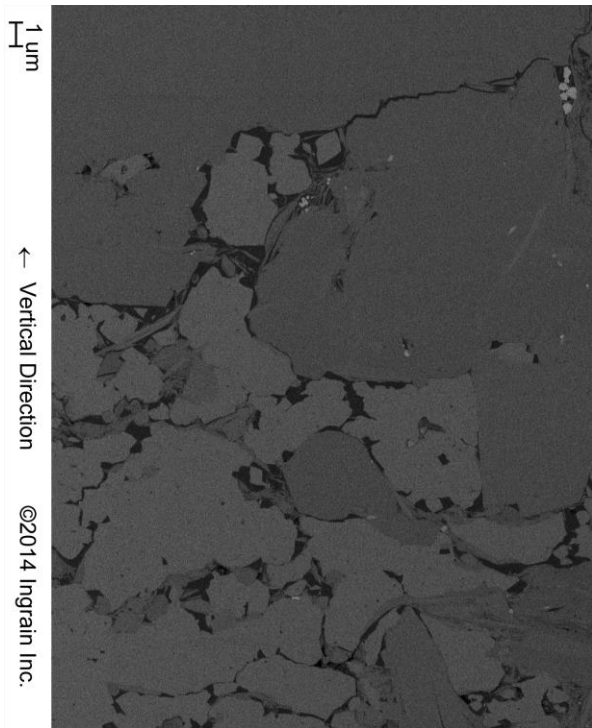
7b. 9141.30 ft., secondary



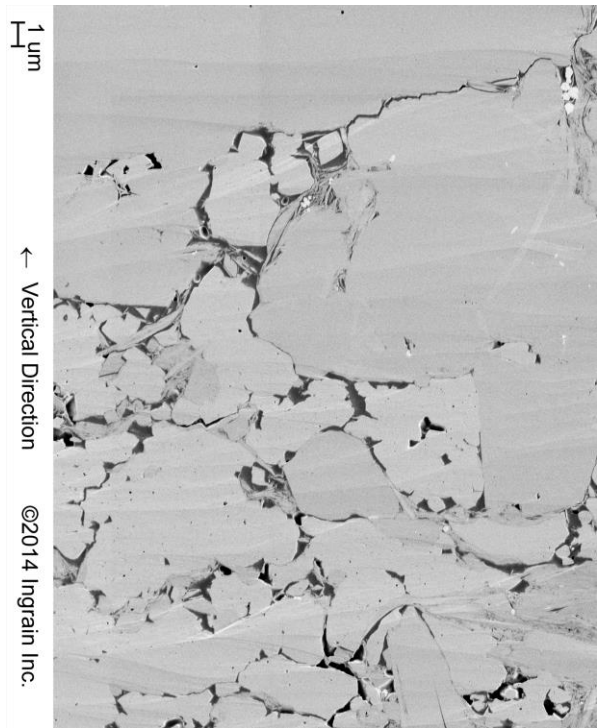
8a. 9141.30 ft., backscatter



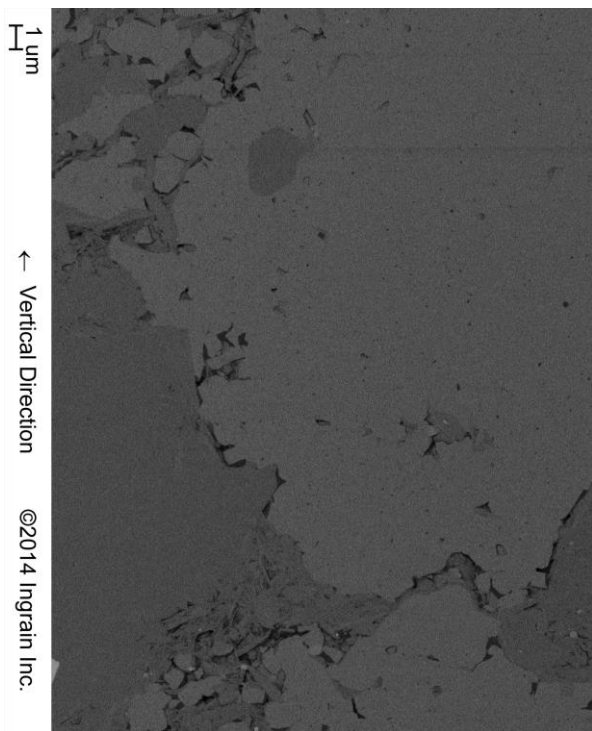
8b. 9141.30 ft., secondary



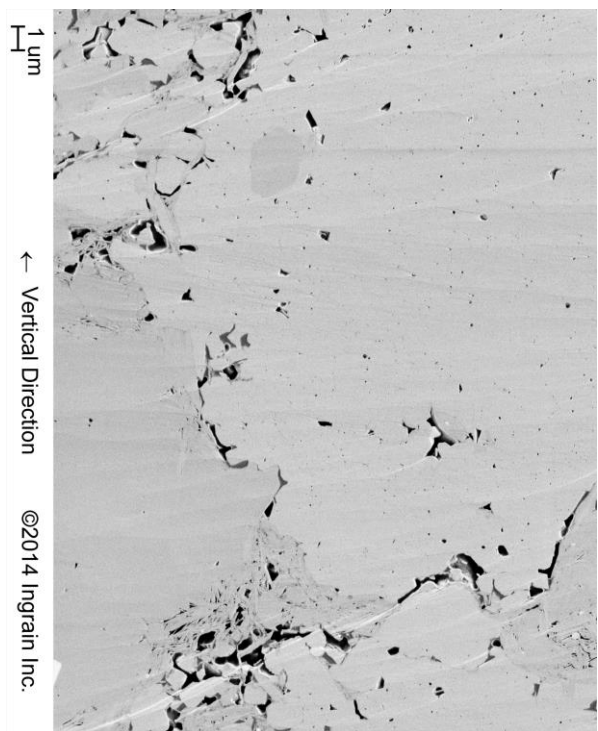
9a. 9141.30 ft., backscatter



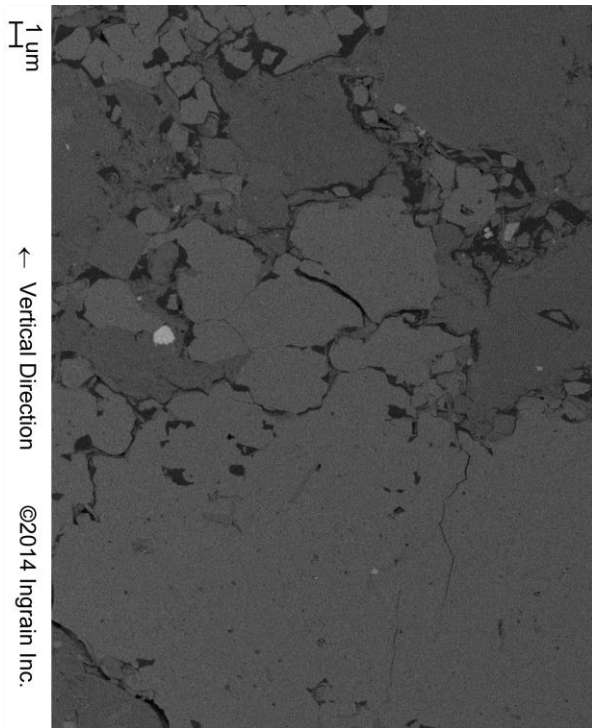
9b. 9141.30 ft., secondary



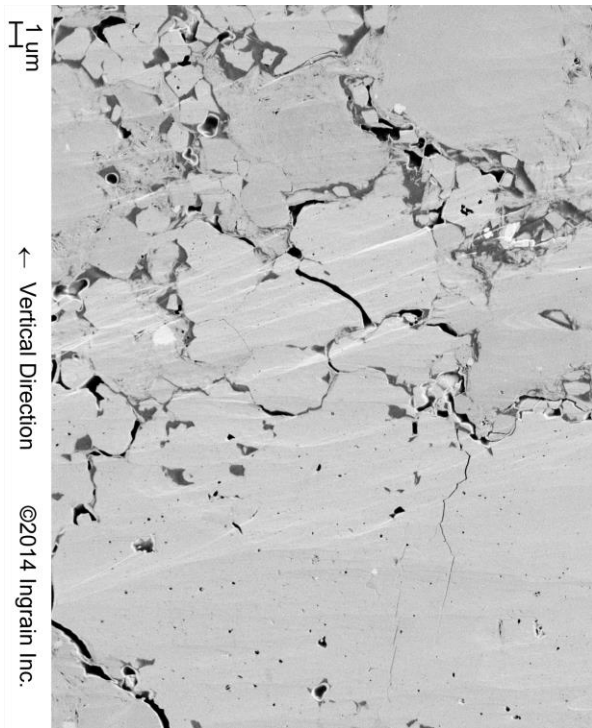
10a. 9141.30 ft., backscatter



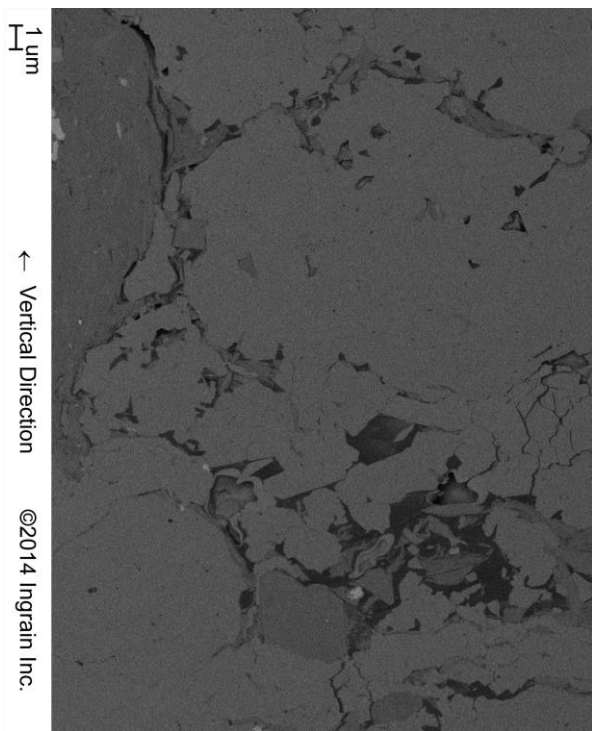
10b. 9141.30 ft., secondary



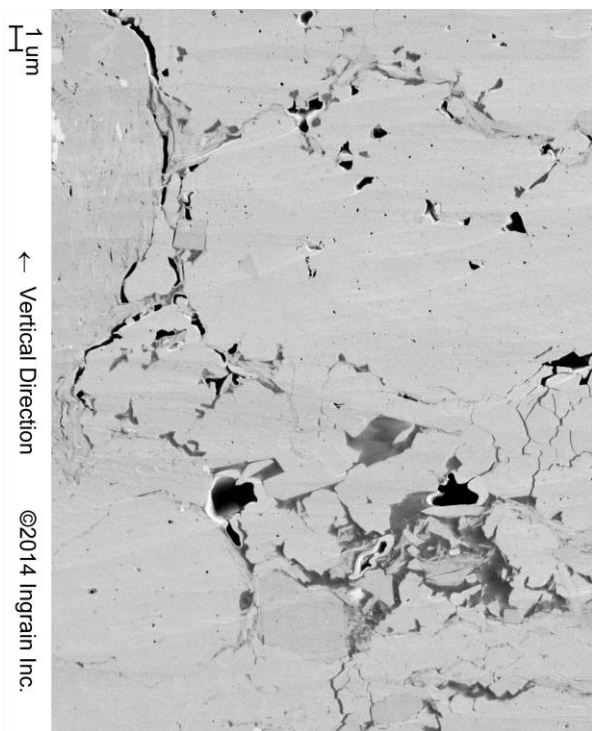
11a. 9141.30 ft., backscatter



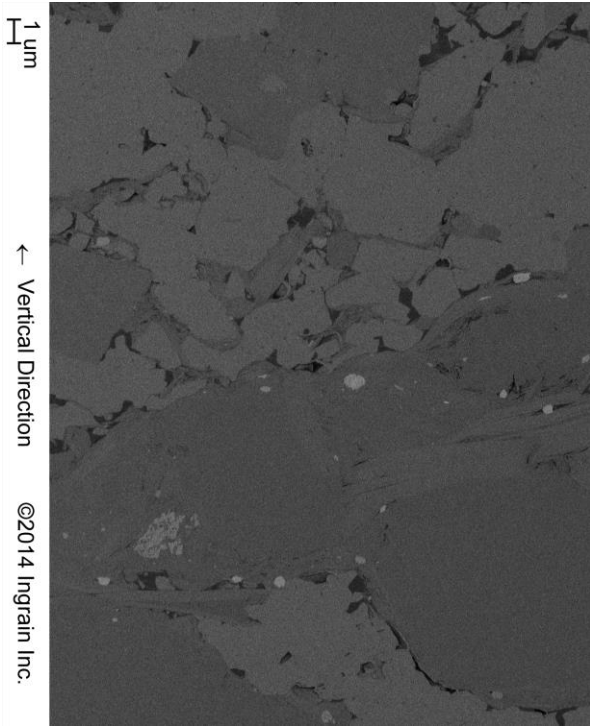
11b. 9141.30 ft., secondary



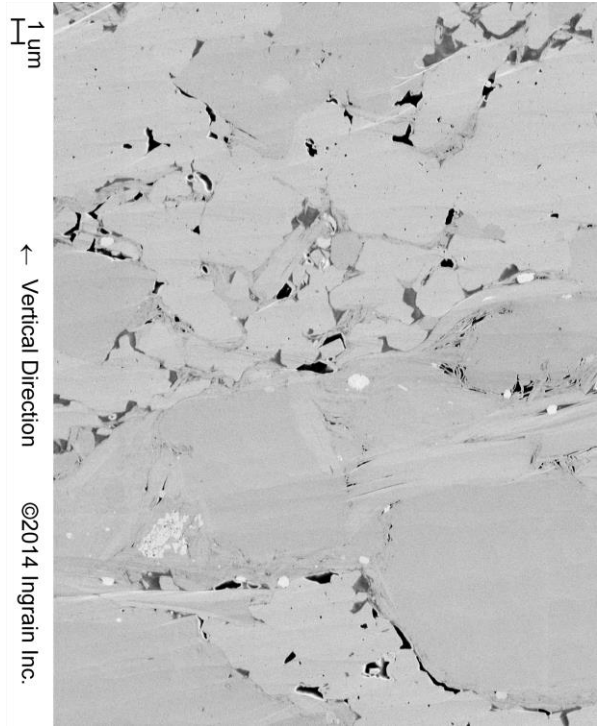
12a. 9141.30 ft., backscatter



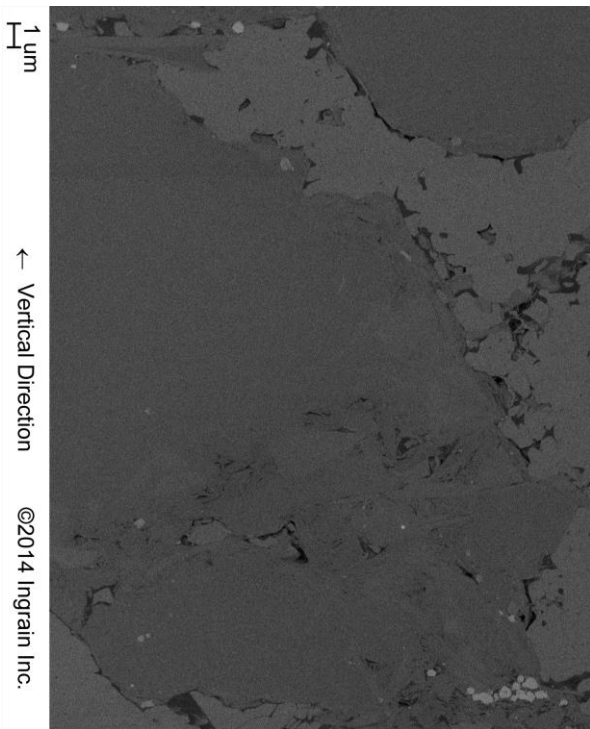
12b. 9141.30 ft., secondary



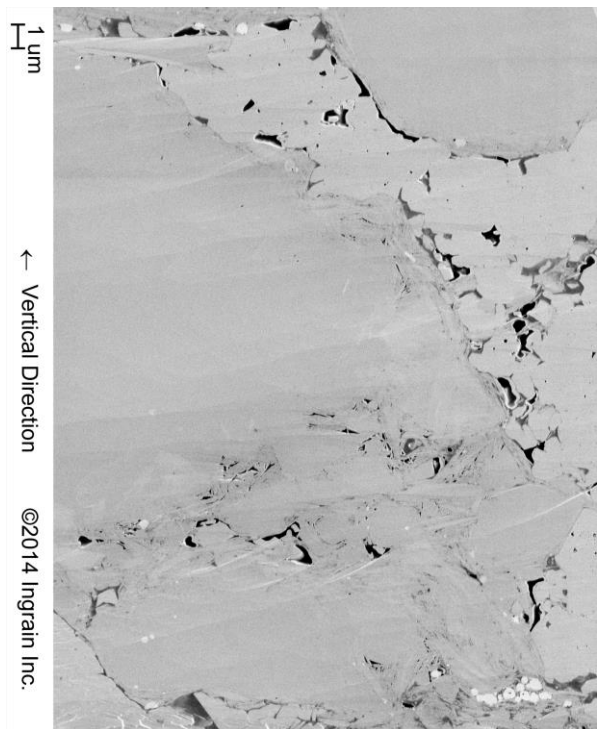
13a. 9141.30 ft., backscatter



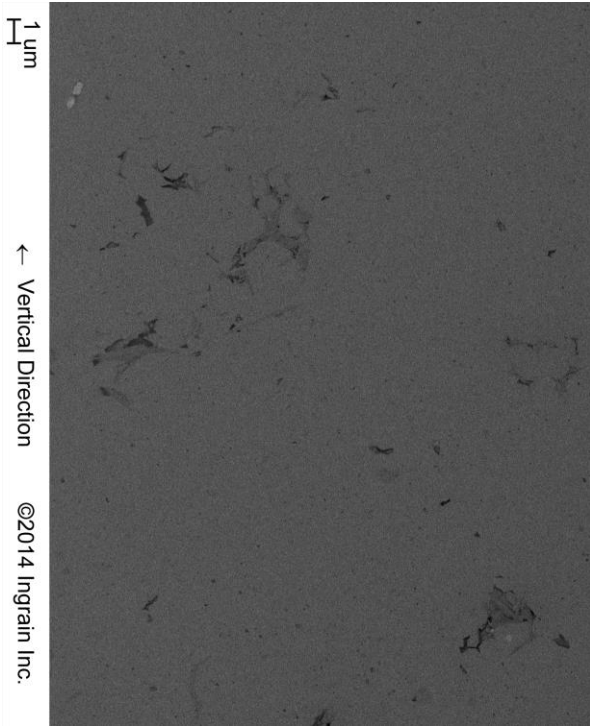
13b. 9141.30 ft., secondary



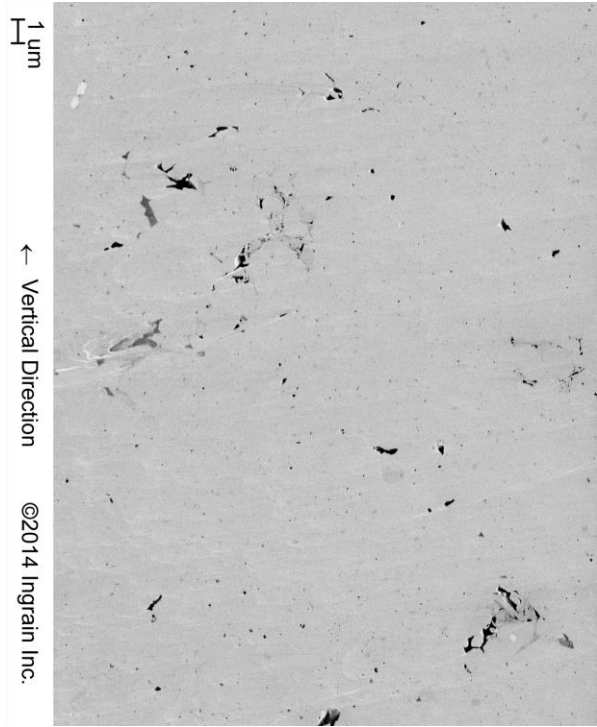
14a. 9141.30 ft., backscatter



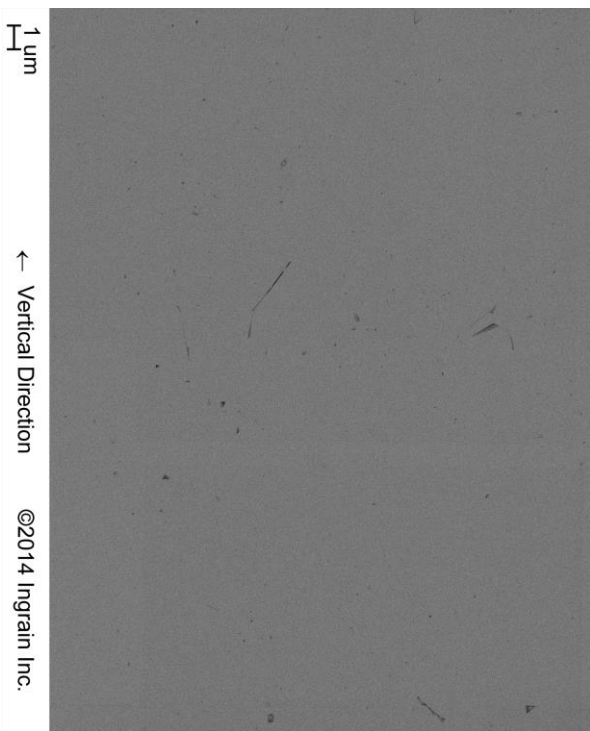
14b. 9141.30 ft., secondary



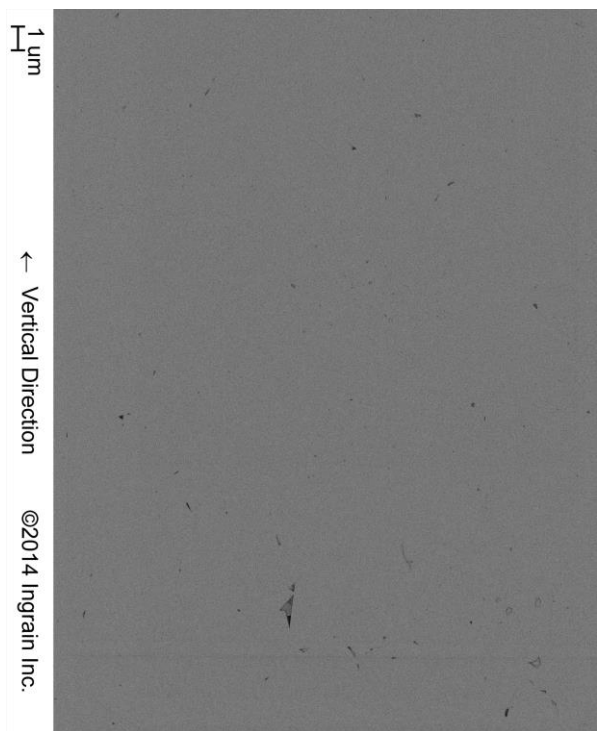
15a. 9141.30 ft., backscatter



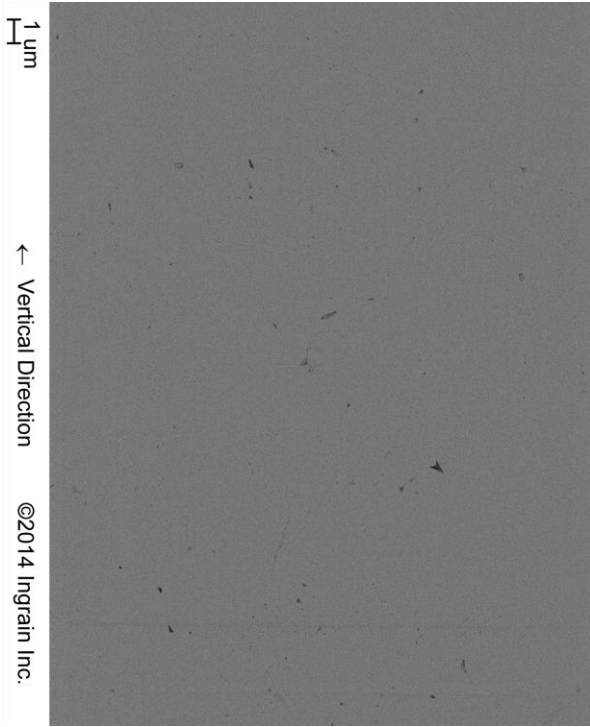
15b. 9141.30 ft., secondary



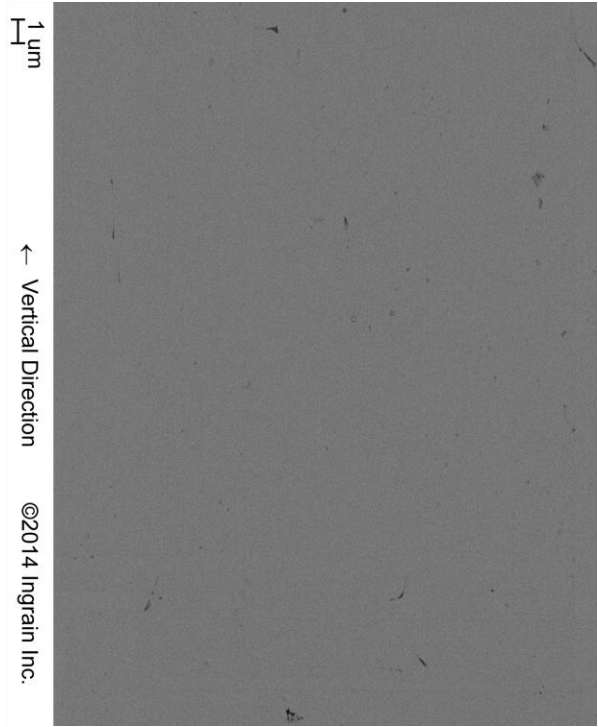
16. 9151.65 ft., backscatter



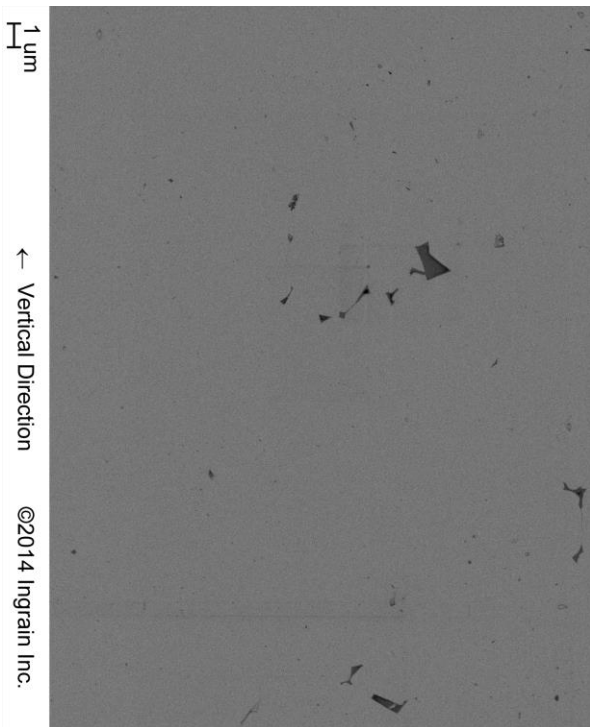
17. 9151.65 ft., backscatter



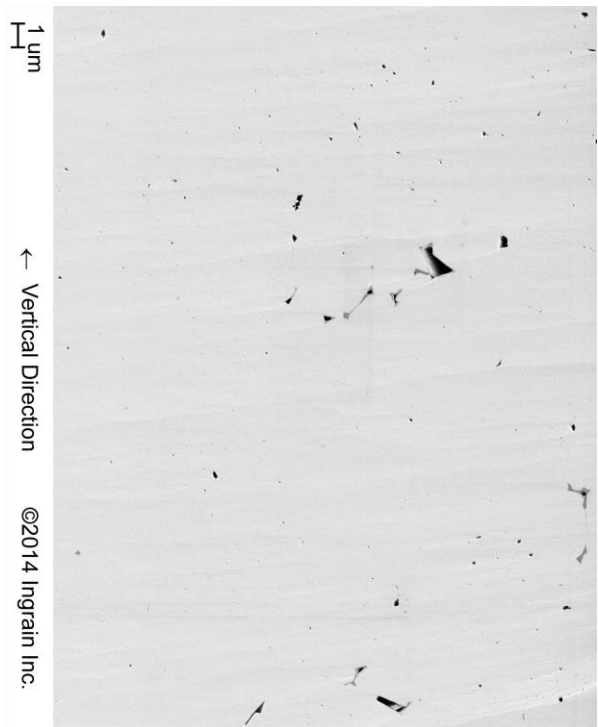
18. 9151.65 ft., backscatter



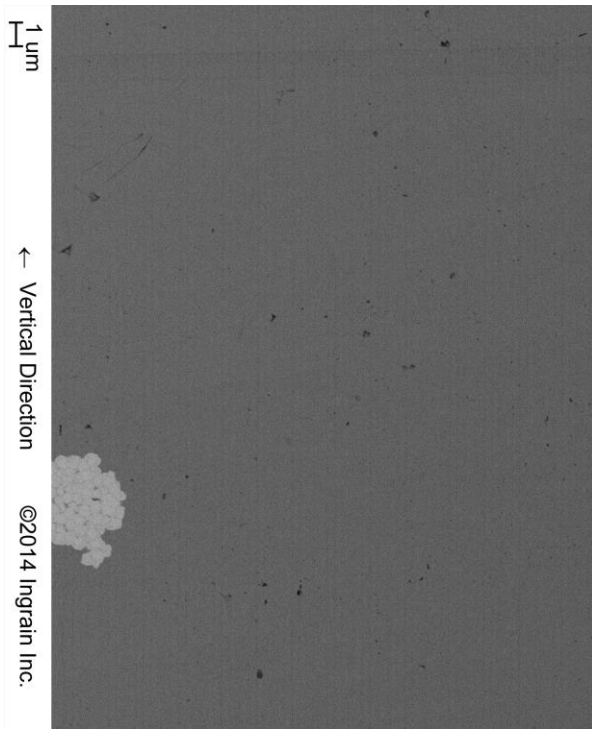
19. 9151.65 ft., backscatter



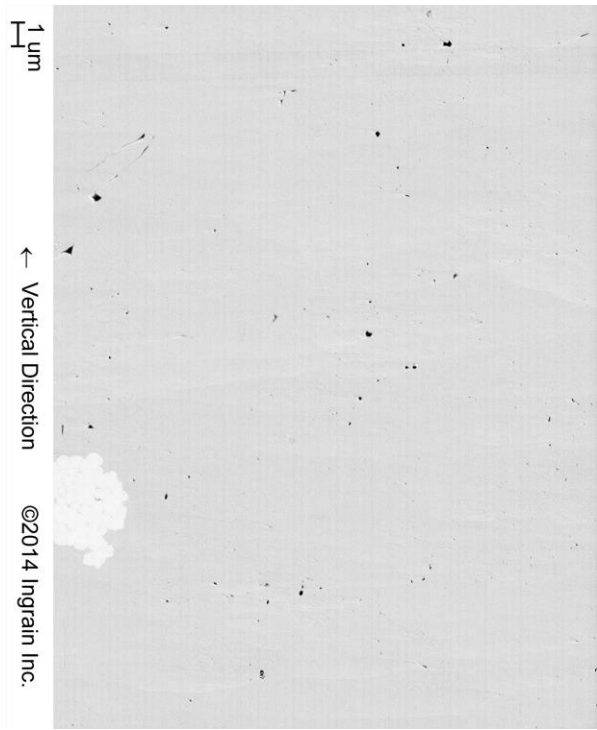
20a. 9151.65 ft., backscatter



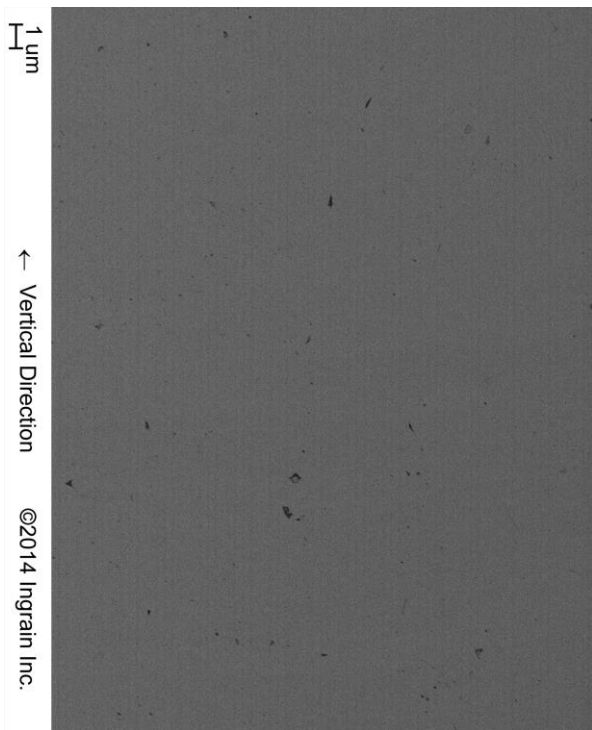
20b. 9151.65 ft., secondary



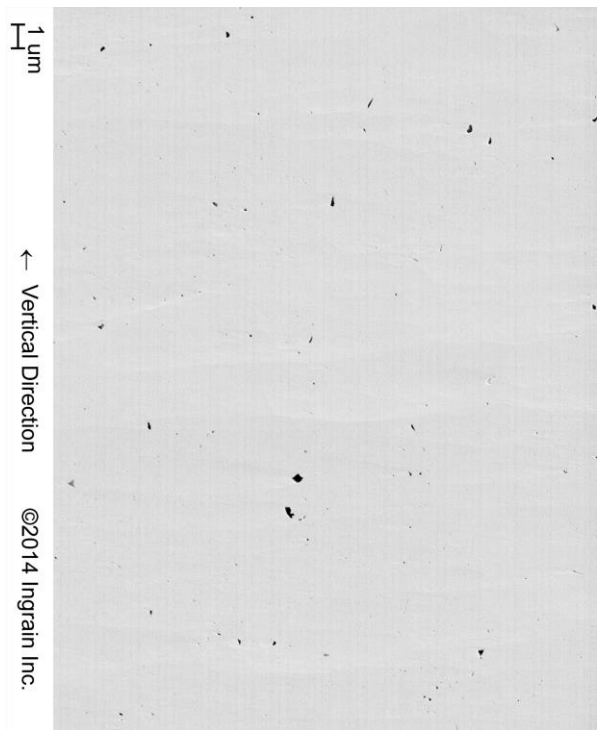
21a. 9151.65 ft., backscatter



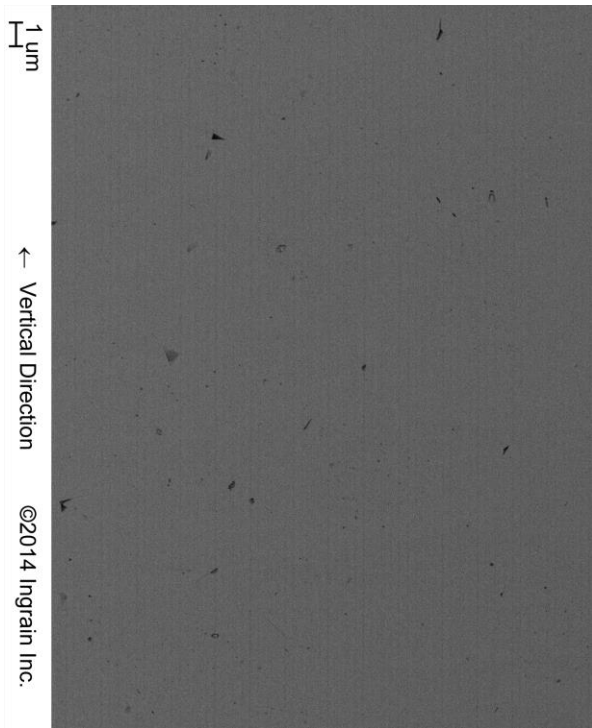
21b. 9151.65 ft., secondary



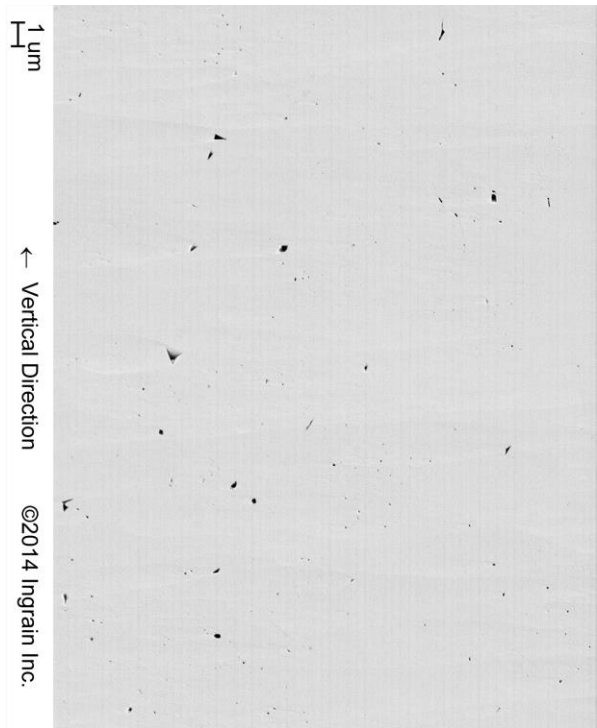
22a. 9151.65 ft., backscatter



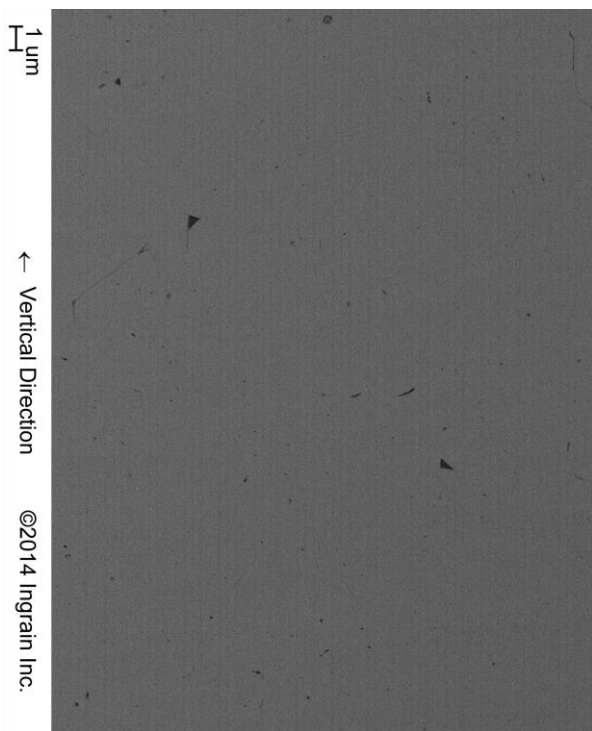
22b. 9151.65 ft., secondary



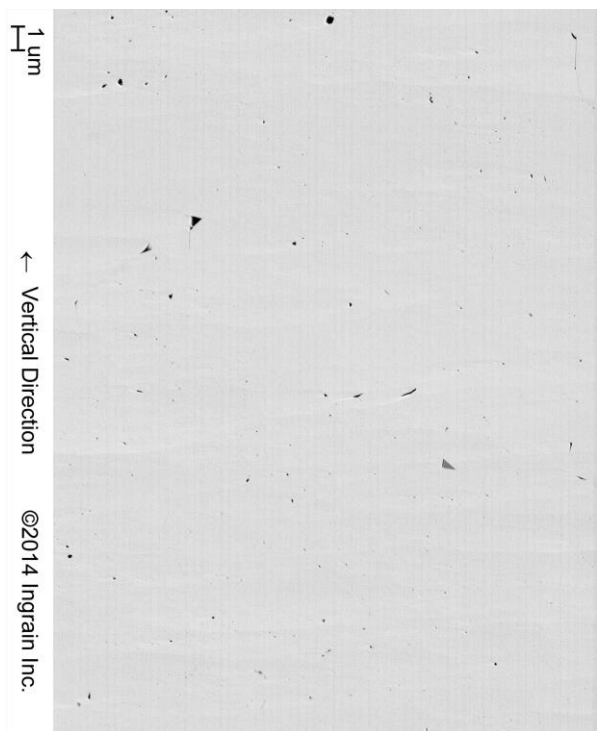
23a. 9151.65 ft., backscatter



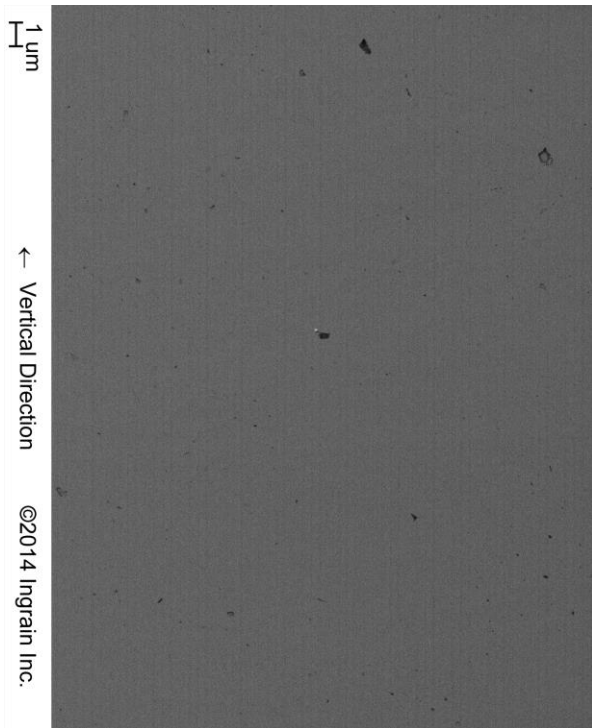
23b. 9151.65 ft., secondary



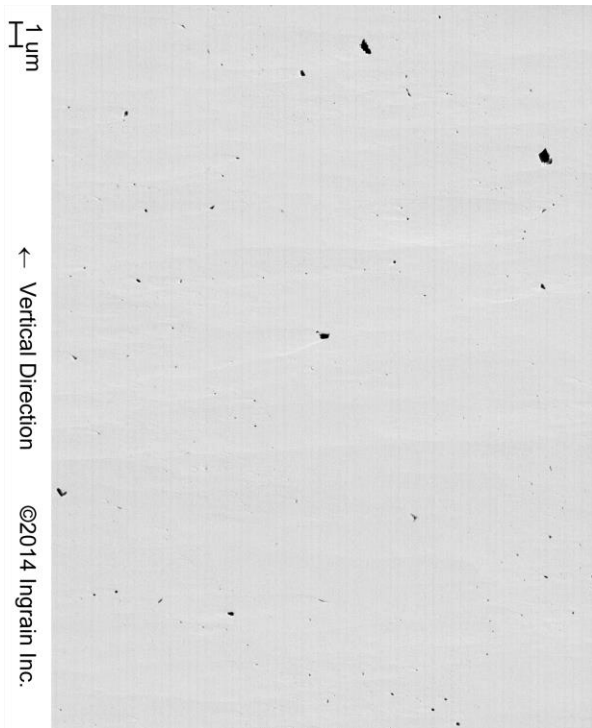
24a. 9151.65 ft., backscatter



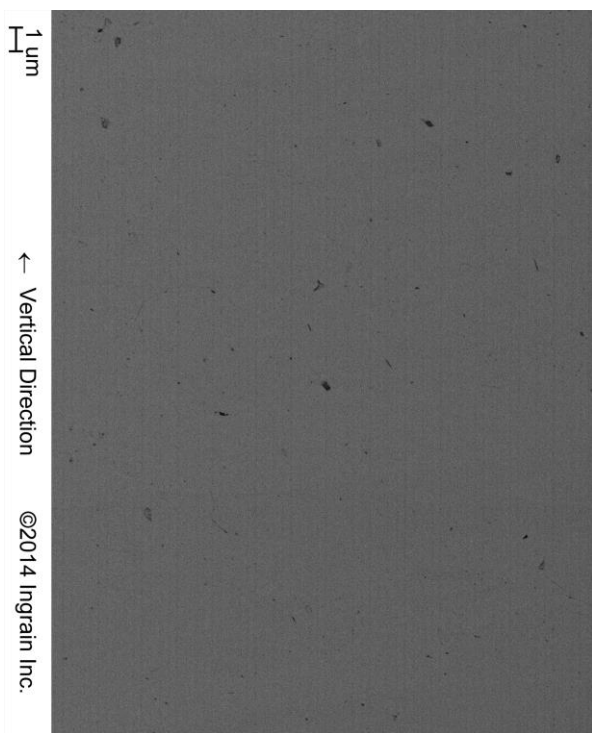
24b. 9151.65 ft., secondary



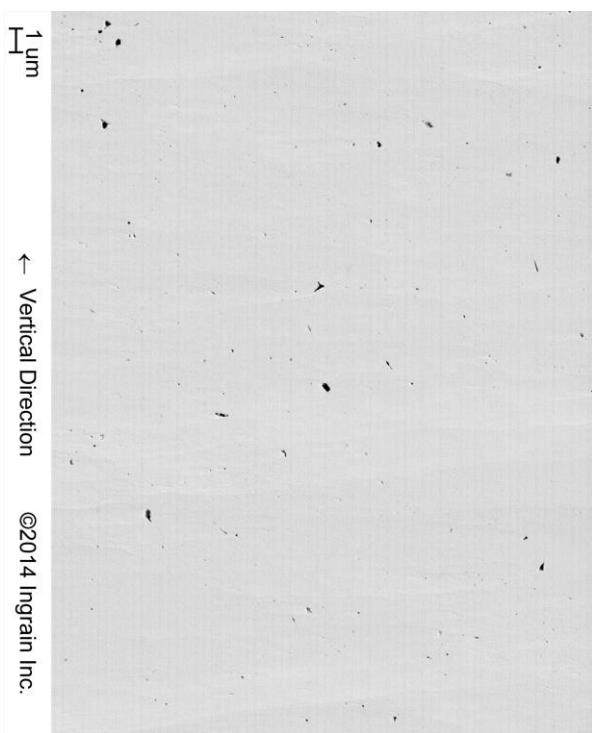
25a. 9151.65 ft., backscatter



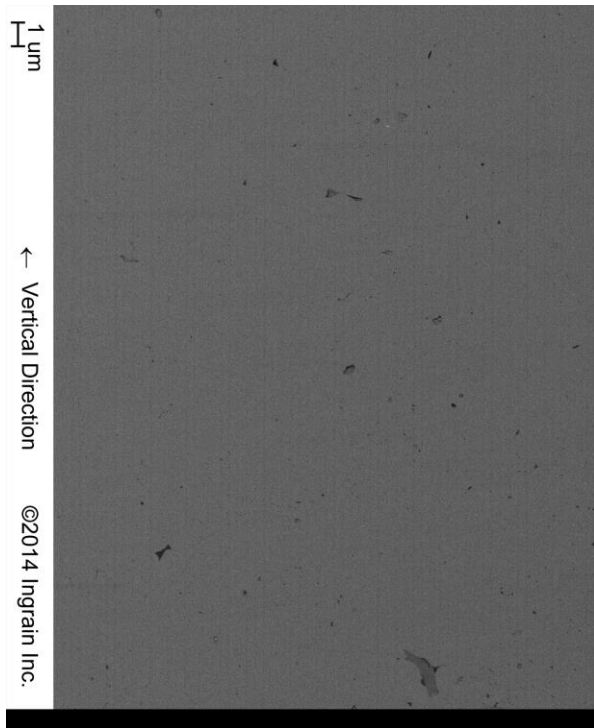
25b. 9151.65 ft., secondary



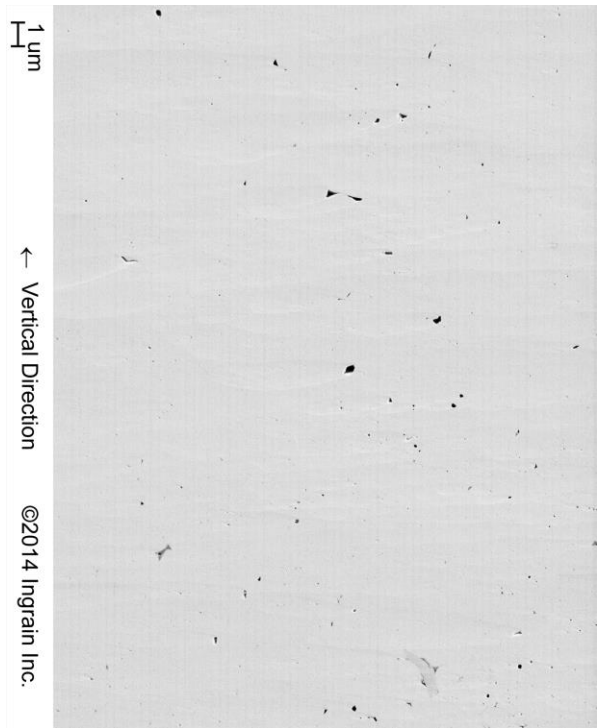
26a. 9151.65 ft., backscatter



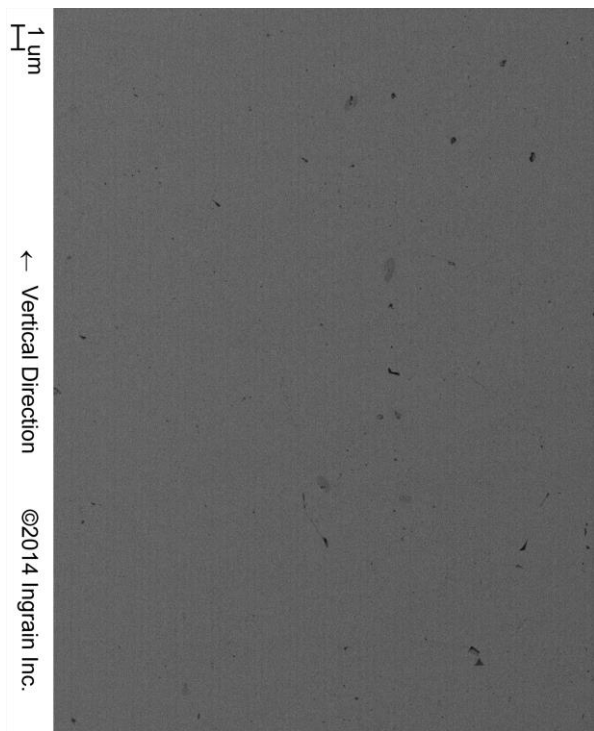
26b. 9151.65 ft., secondary



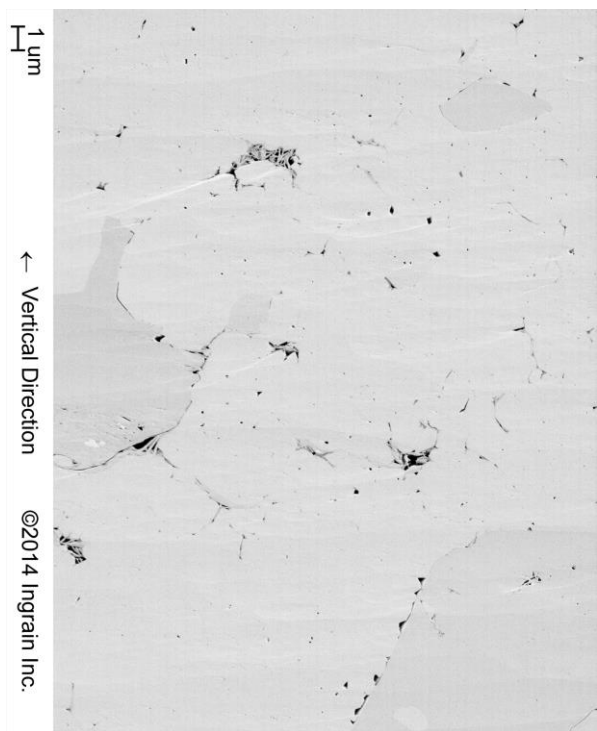
27a. 9151.65 ft., backscatter



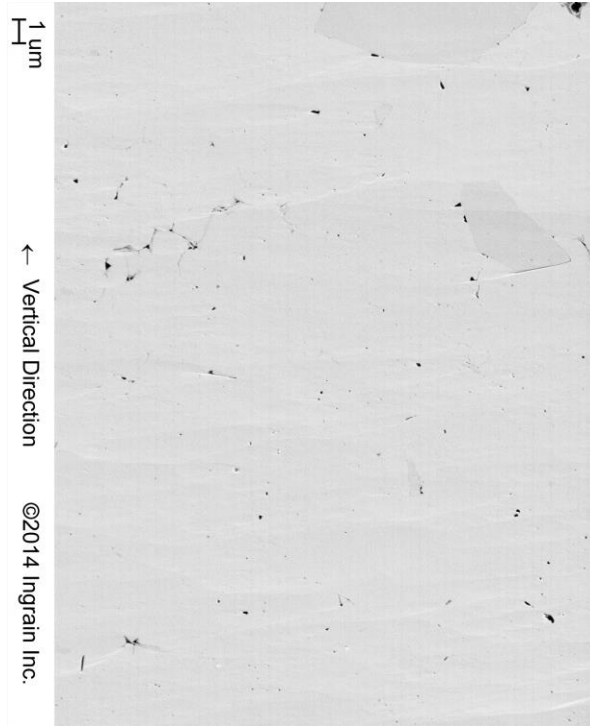
27b. 9151.65 ft., secondary



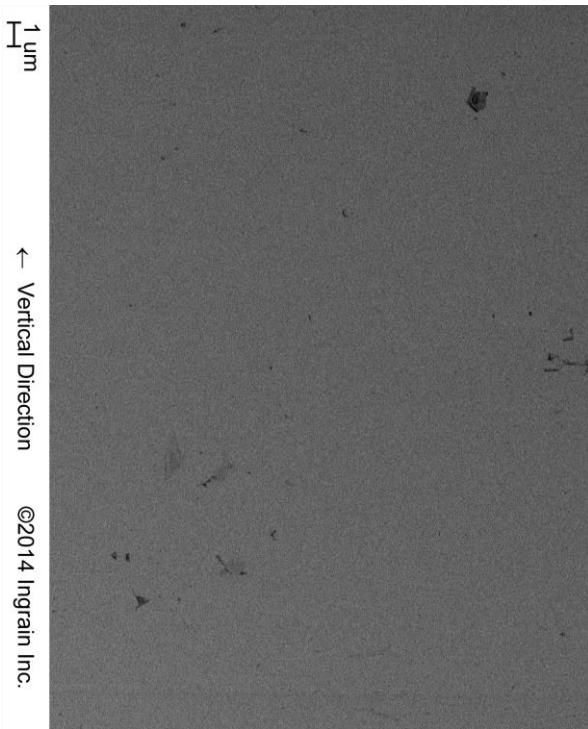
28. 9151.65 ft., backscatter



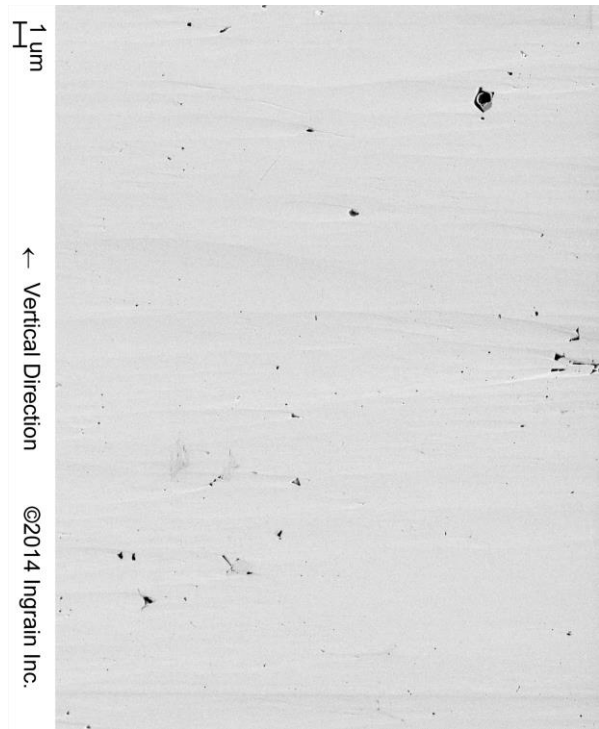
29. 9151.65 ft., secondary



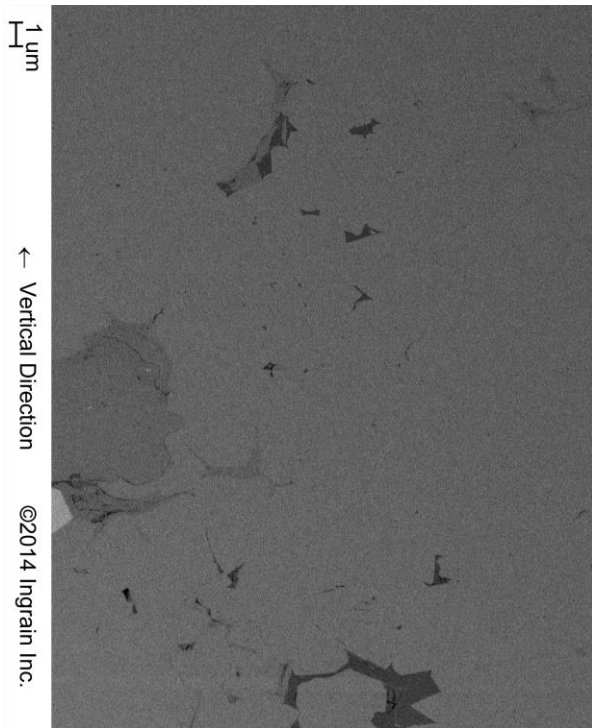
30. 9151.65 ft., secondary



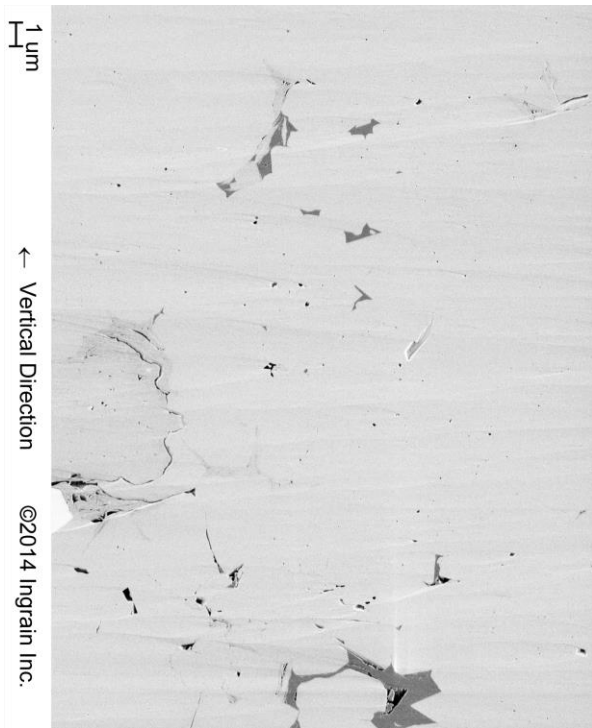
31a. 9159.75 ft., backscatter



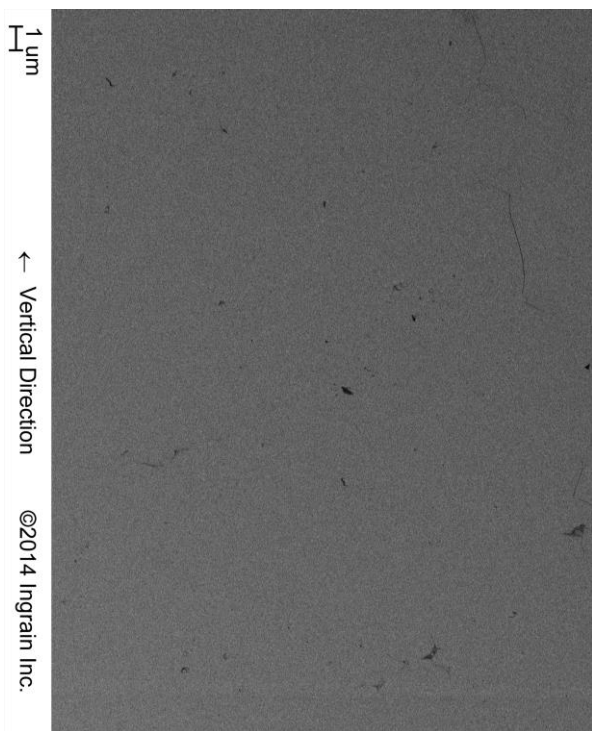
31b. 9159.75 ft., secondary



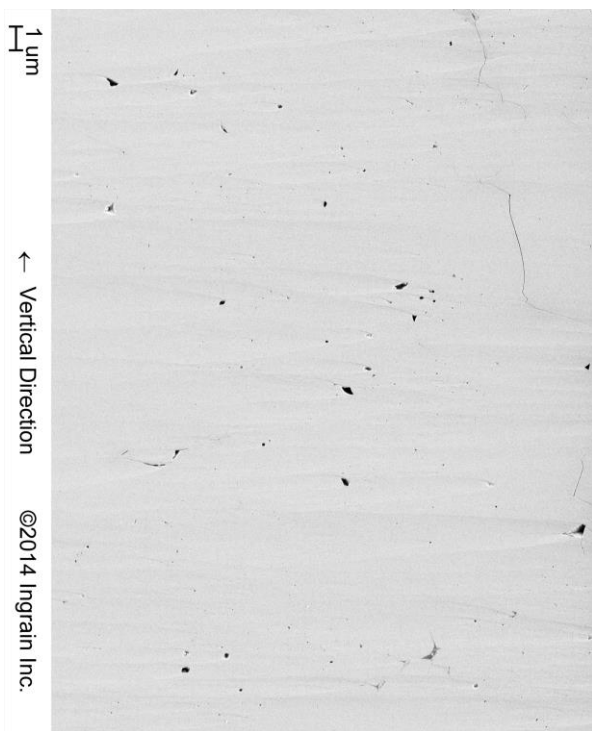
32a. 9159.75 ft., backscatter



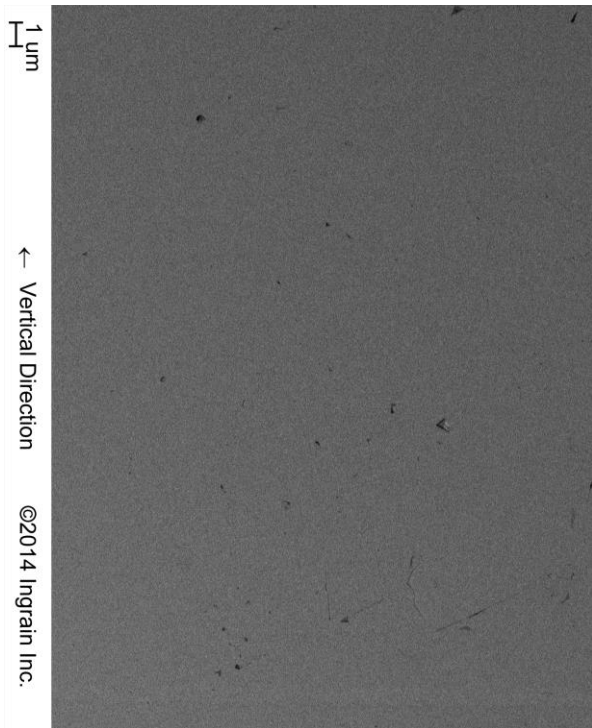
32b. 9159.75 ft., secondary



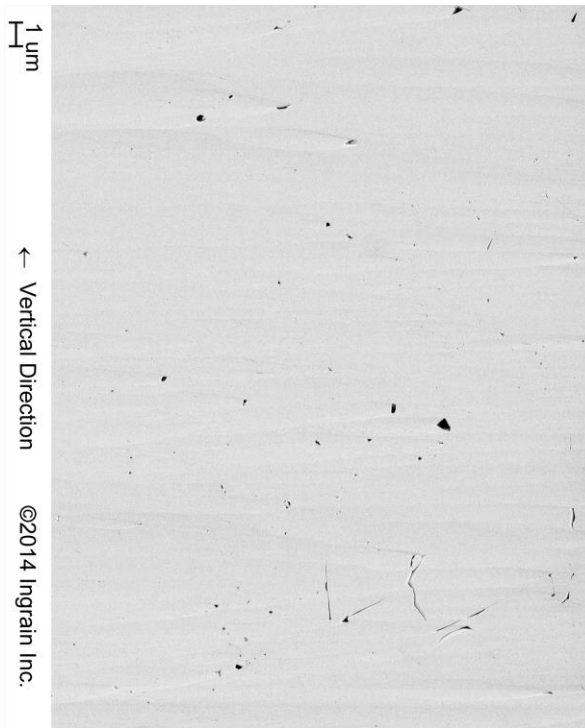
33a. 9159.75 ft., backscatter



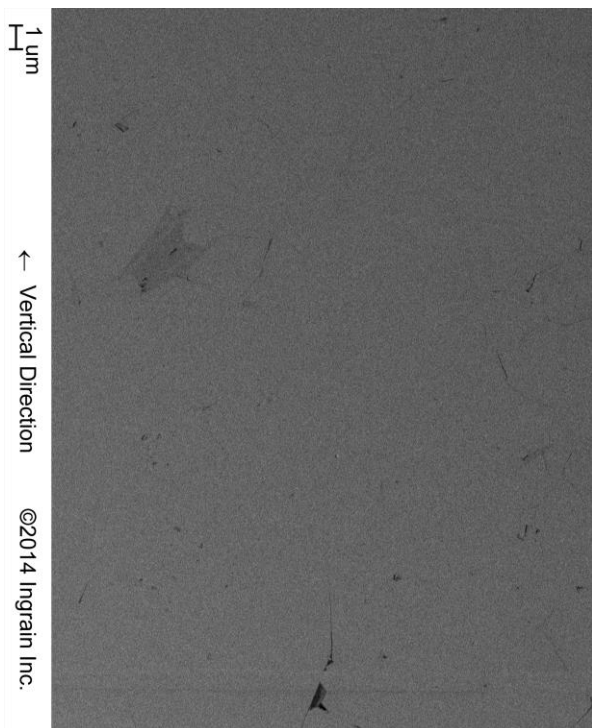
33b. 9159.75 ft., secondary



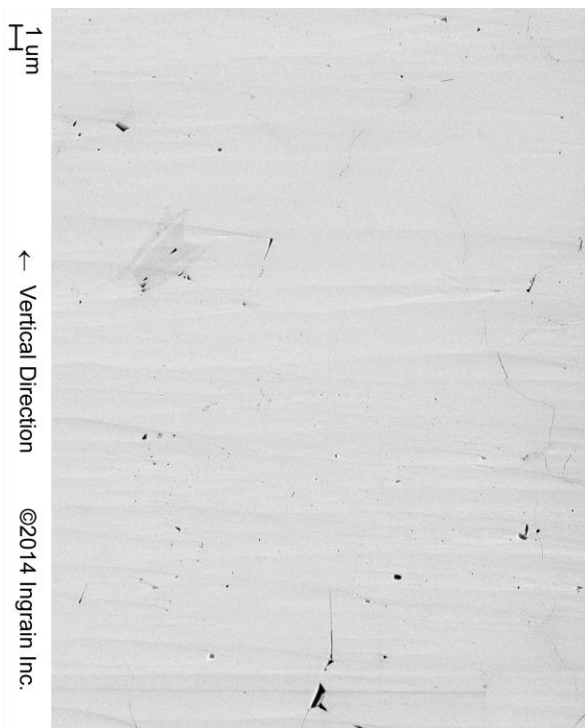
34a. 9159.75 ft., backscatter



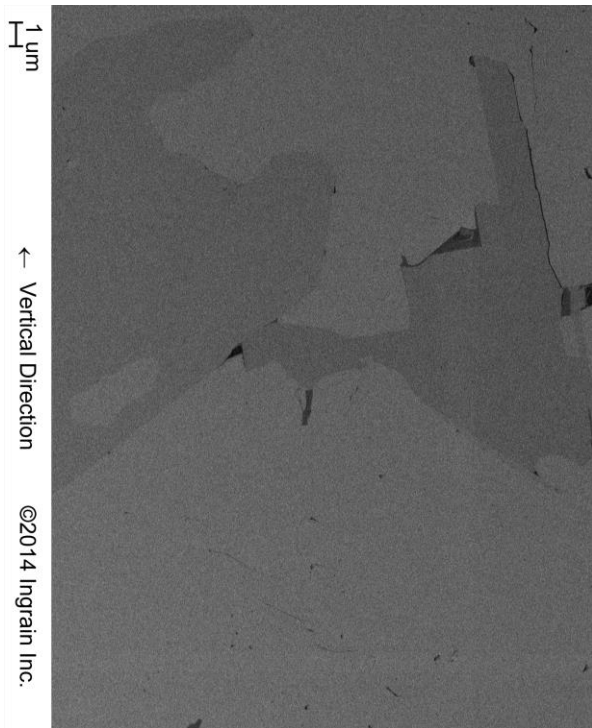
34b. 9159.75 ft., secondary



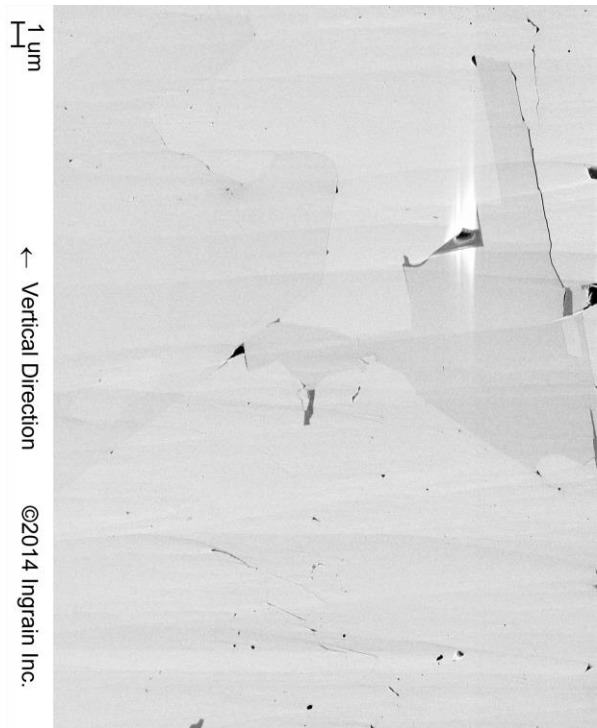
35a. 9159.75 ft., backscatter



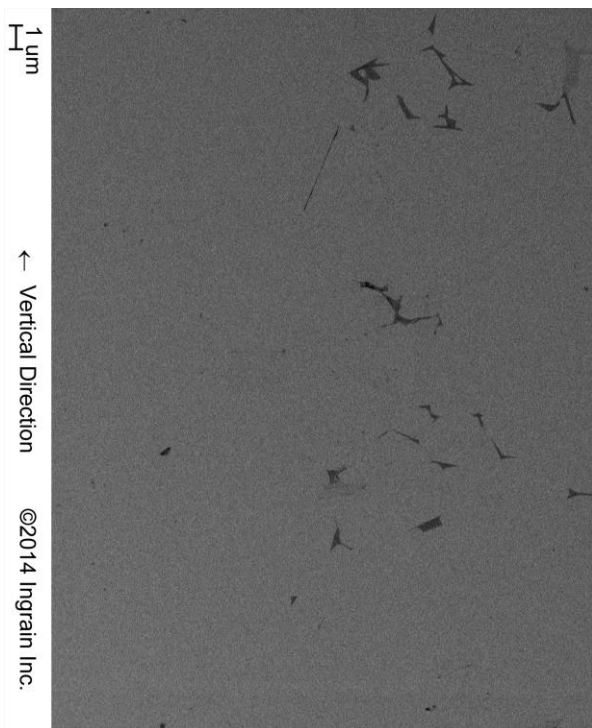
35b. 9159.75 ft., secondary



36a. 9159.75 ft., backscatter



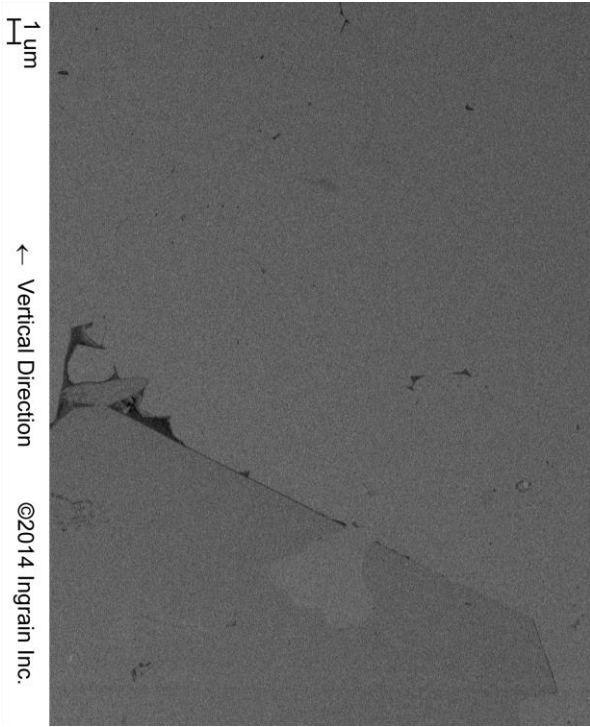
36b. 9159.75 ft., secondary



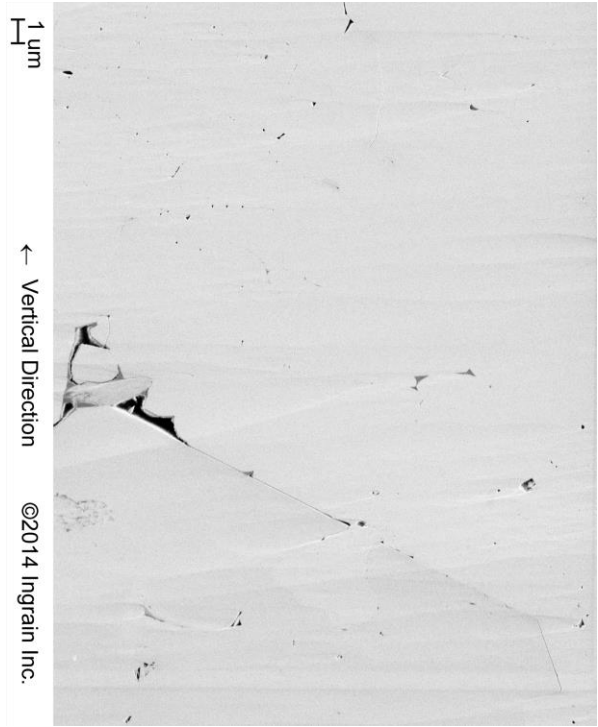
37a. 9159.75 ft., backscatter



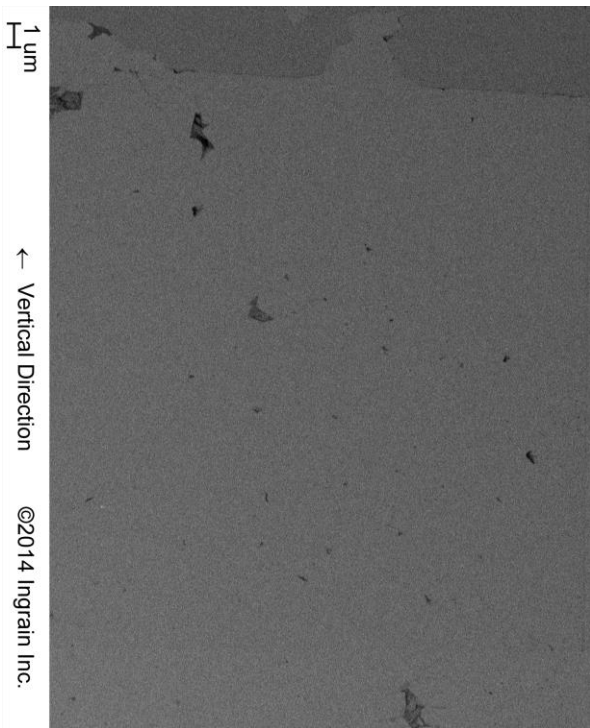
37b. 9159.75 ft., secondary



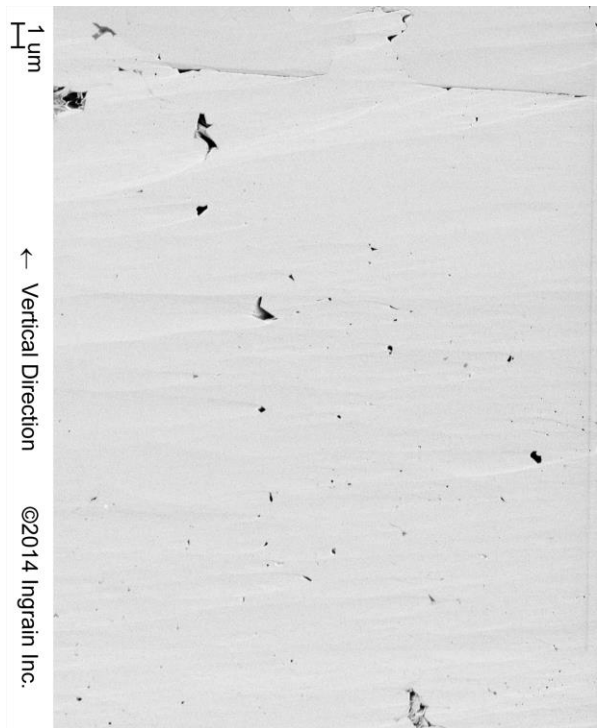
38a. 9159.75 ft., backscatter



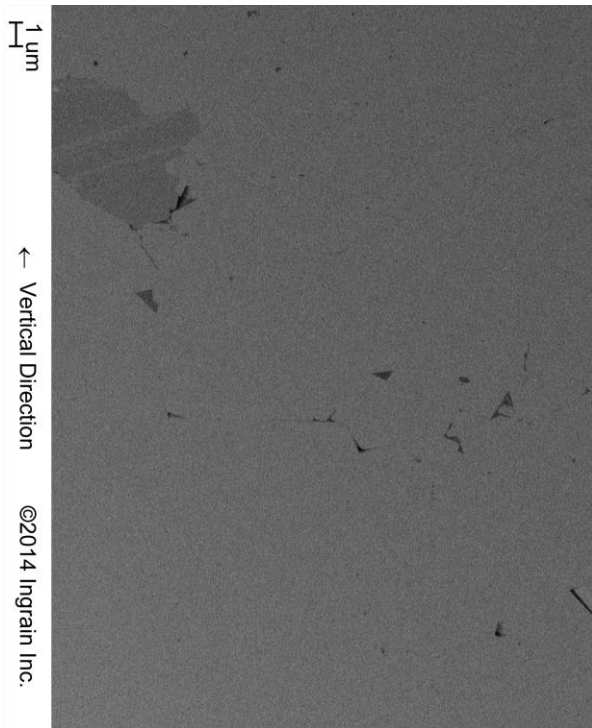
38b. 9159.75 ft., secondary



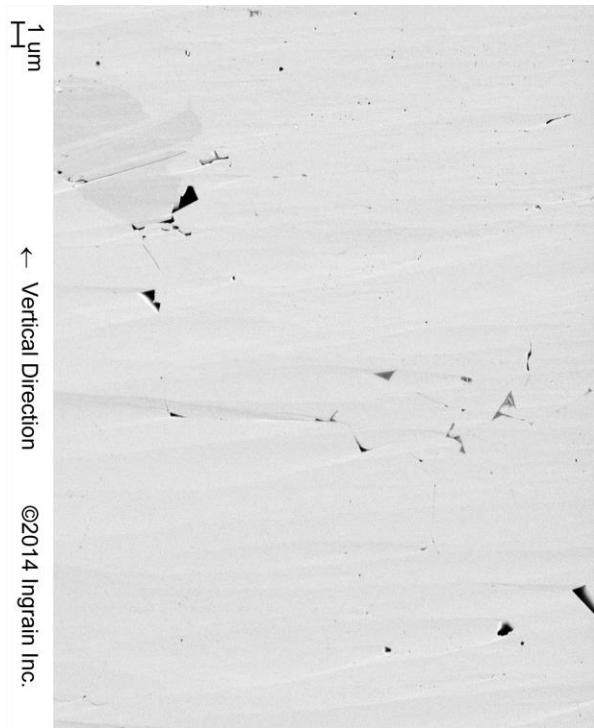
39a. 9159.75 ft., backscatter



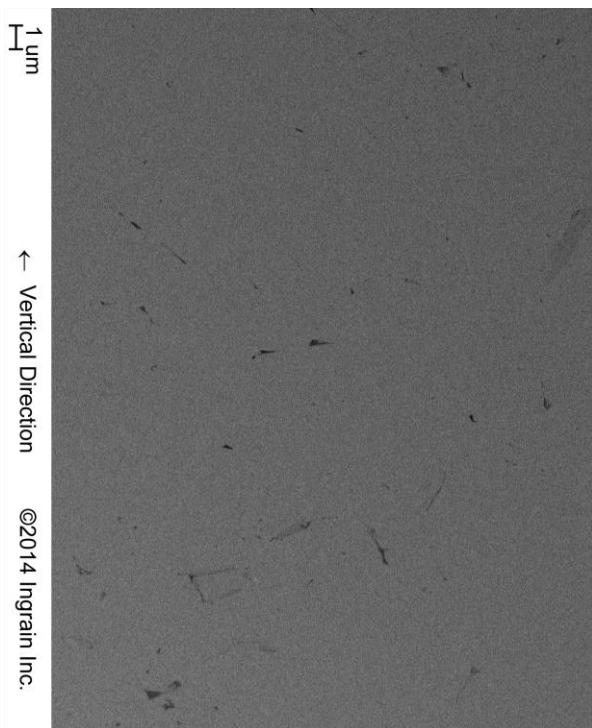
39b. 9159.75 ft., secondary



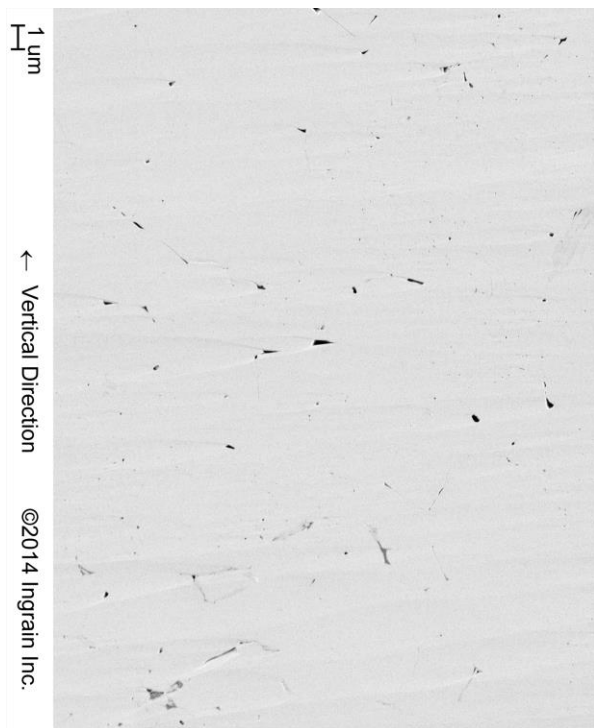
40a. 9159.75 ft., backscatter



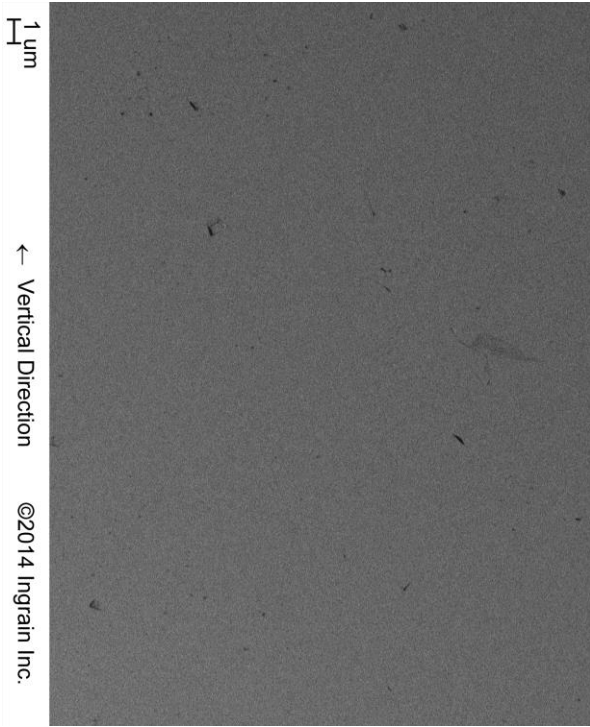
40b. 9159.75 ft., secondary



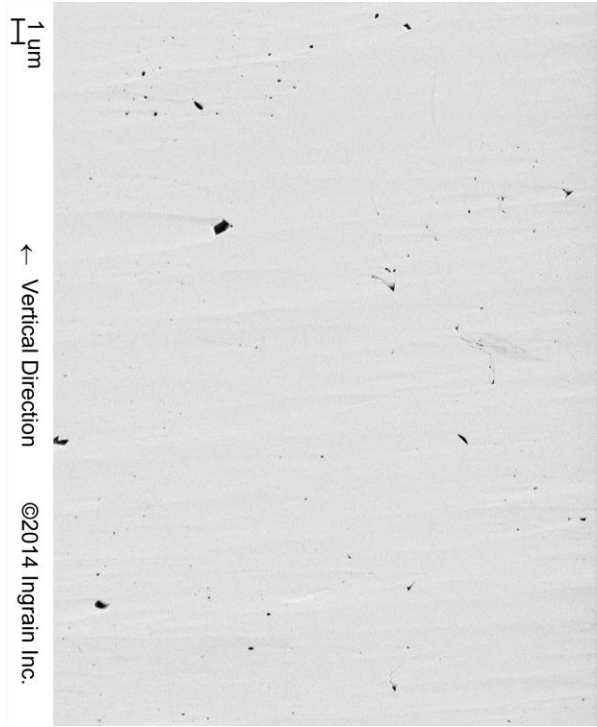
41a. 9159.75 ft., backscatter



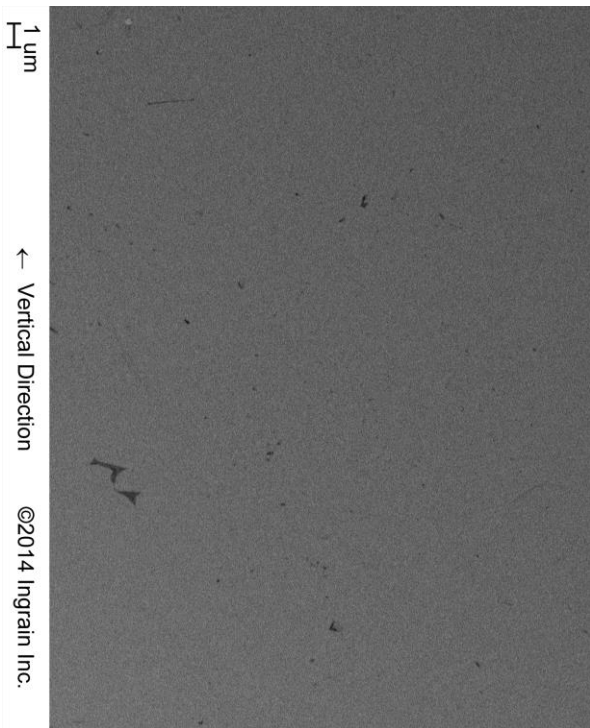
41b. 9159.75 ft., secondary



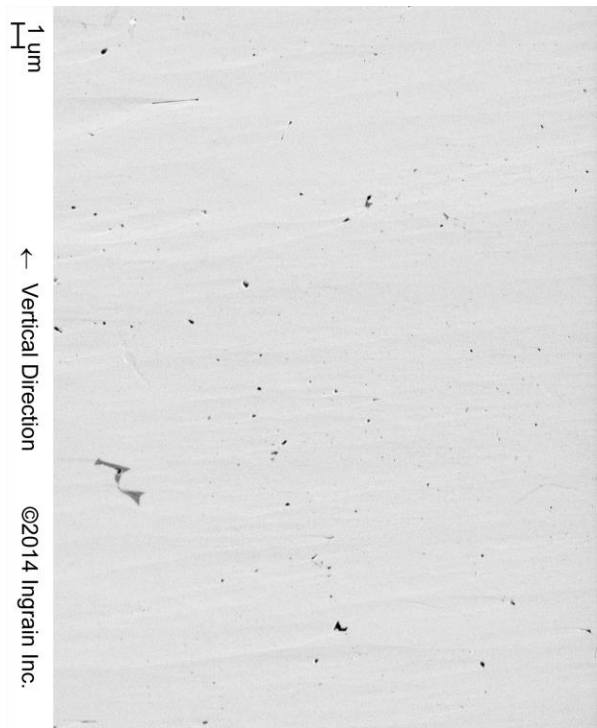
42a. 9159.75 ft., backscatter



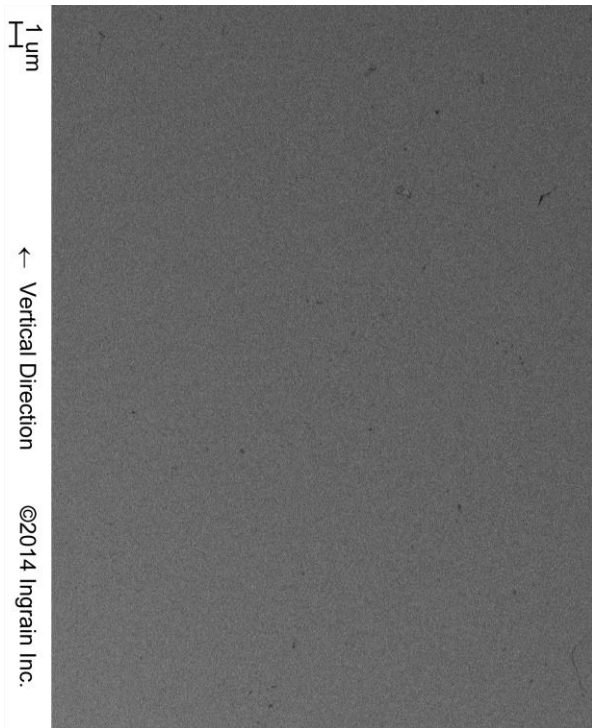
42b. 9159.75 ft., secondary



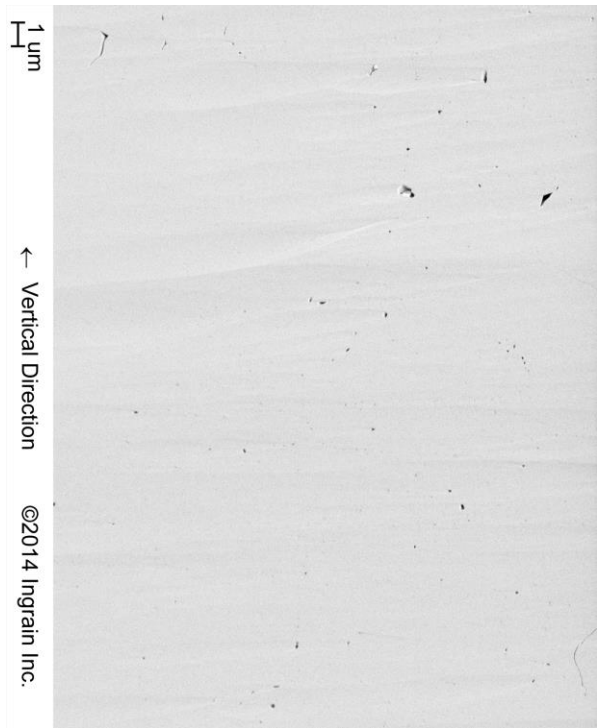
43a. 9159.75 ft., backscatter



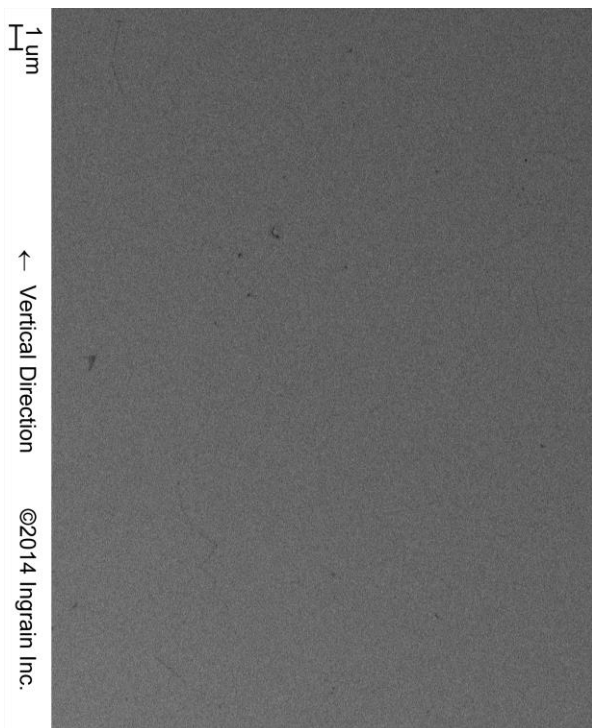
43b. 9159.75 ft., secondary



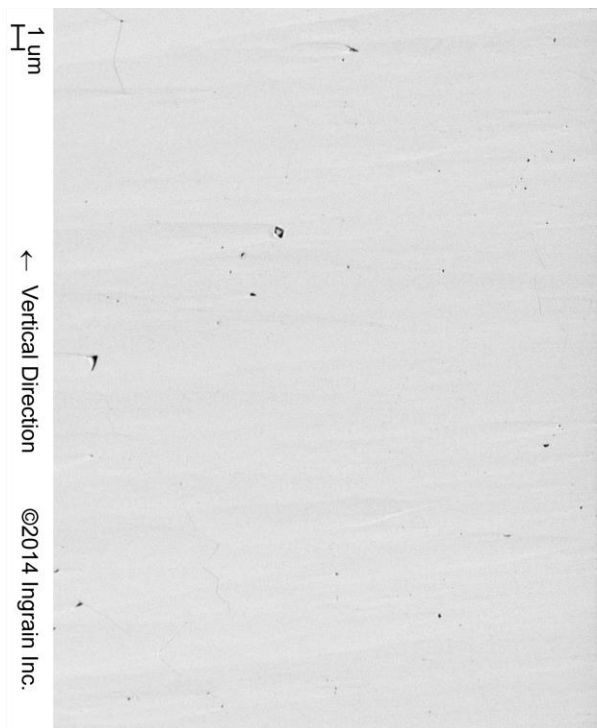
44a. 9159.75 ft., backscatter



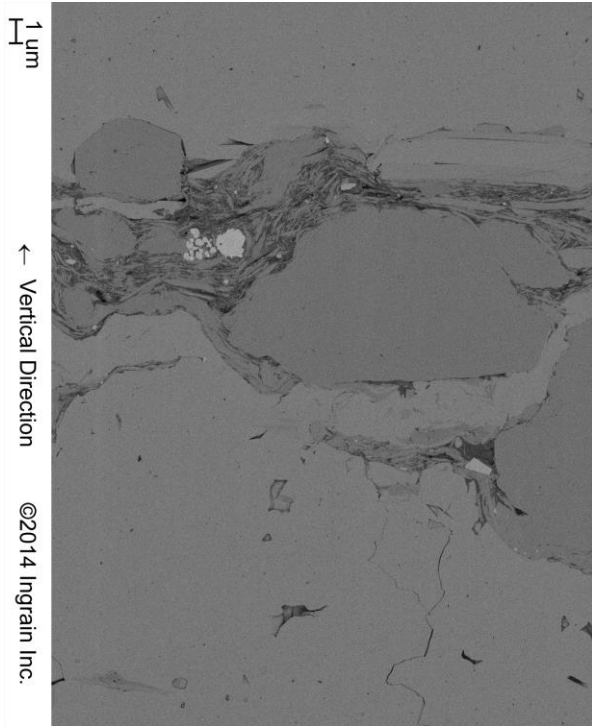
44b. 9159.75 ft., secondary



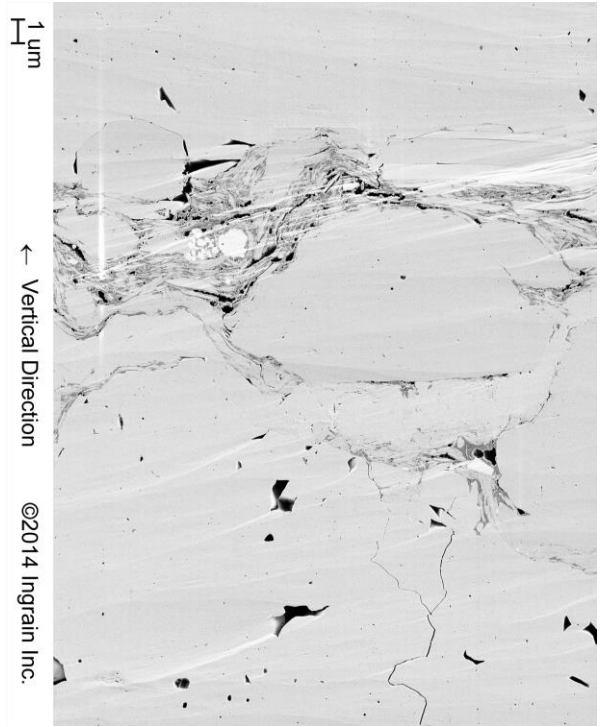
45a. 9159.75 ft., backscatter



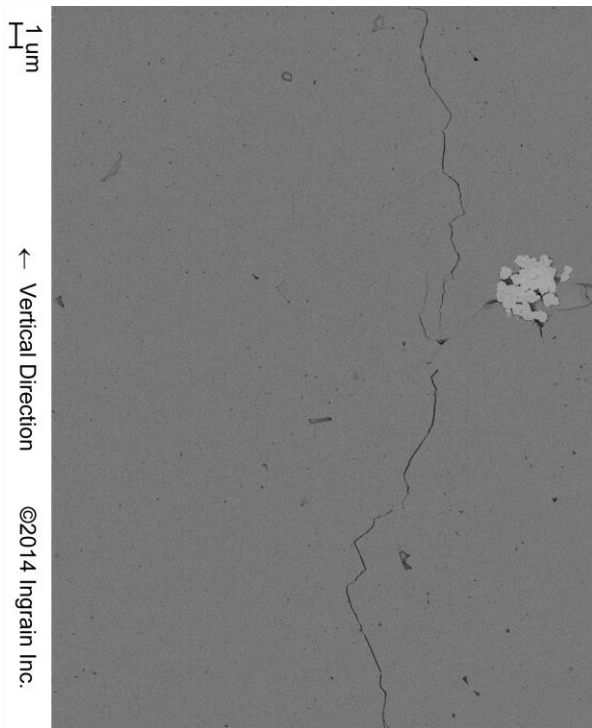
45b. 9159.75 ft., secondary



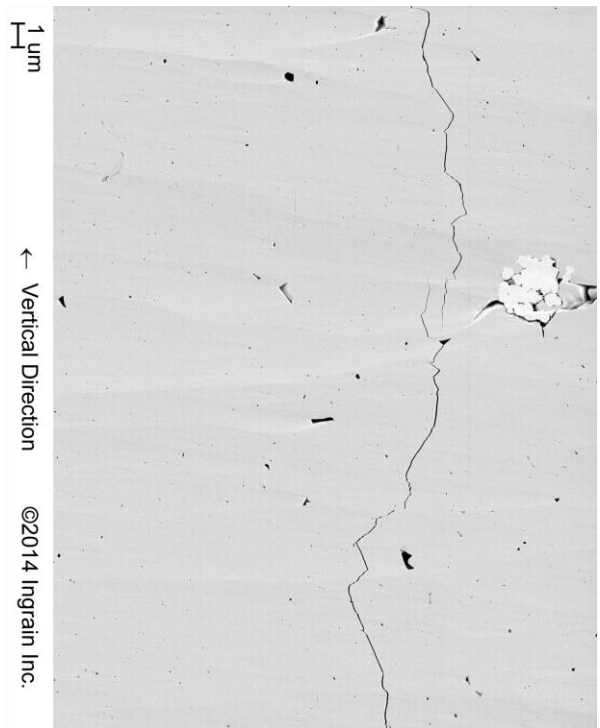
46a. 9167.95 ft., backscatter



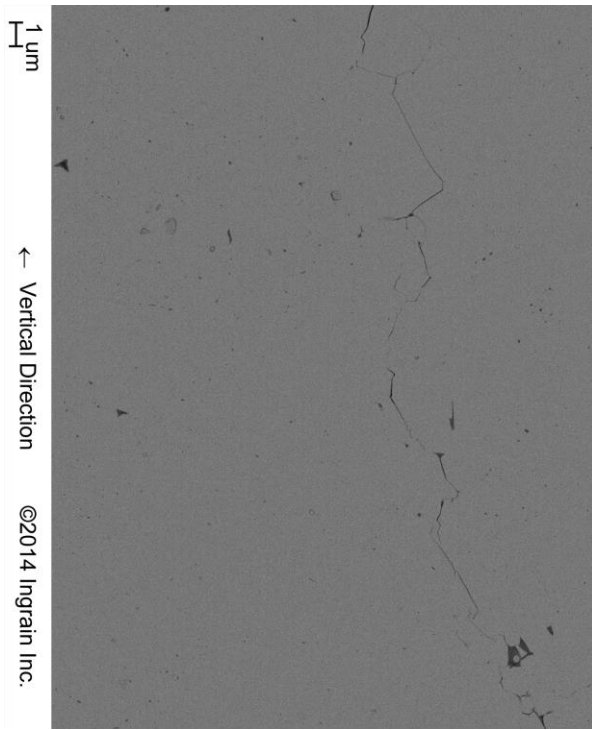
46b. 9167.95 ft., secondary



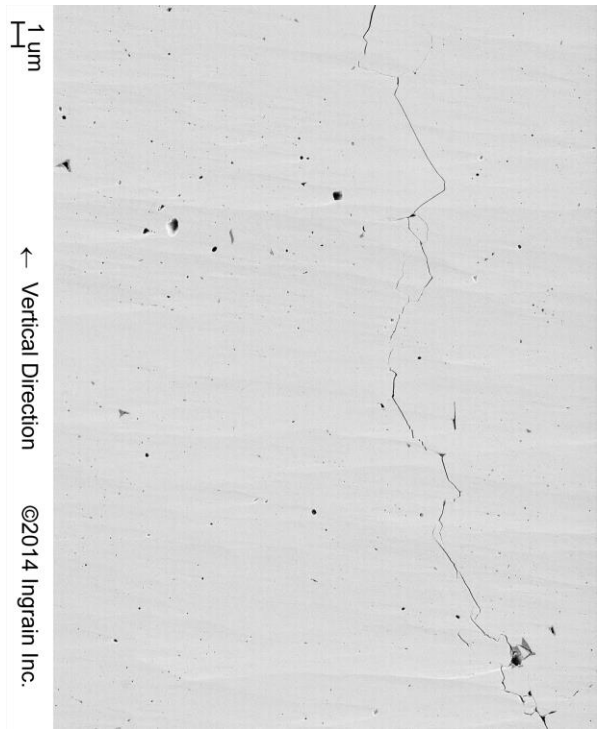
47a. 9167.95 ft., backscatter



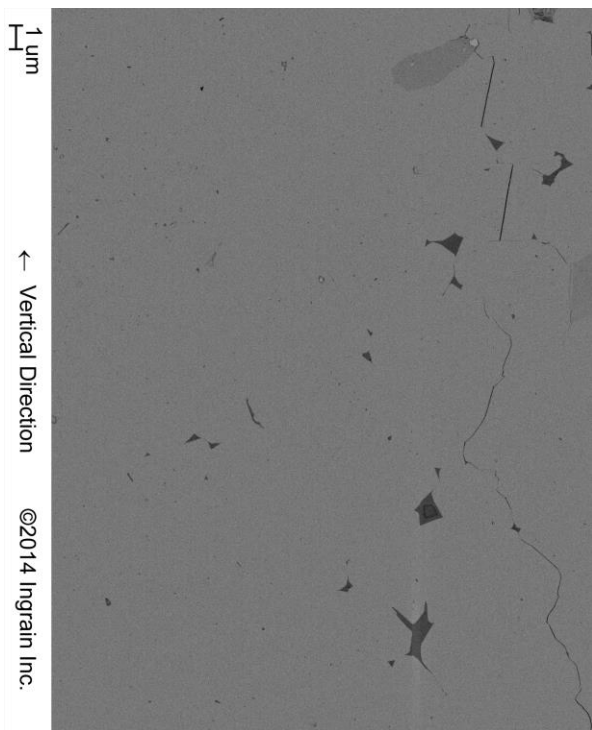
47b. 9167.95 ft., secondary



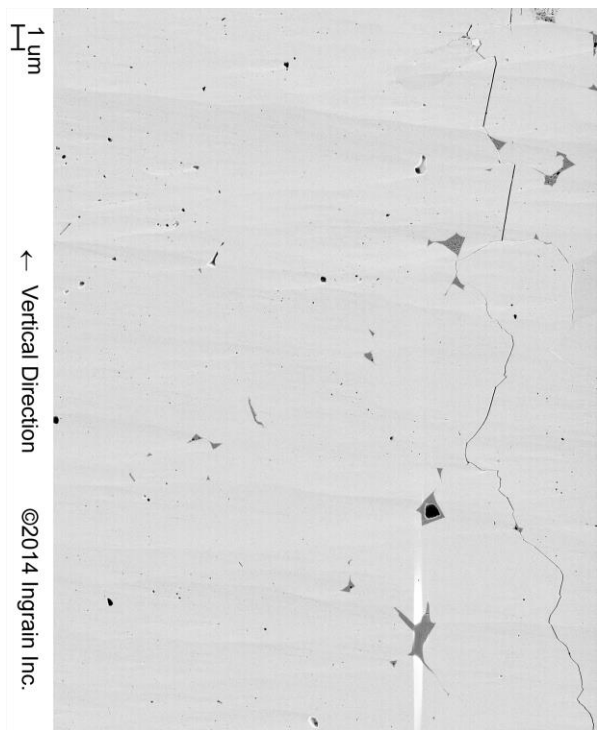
48a. 9167.95 ft., backscatter



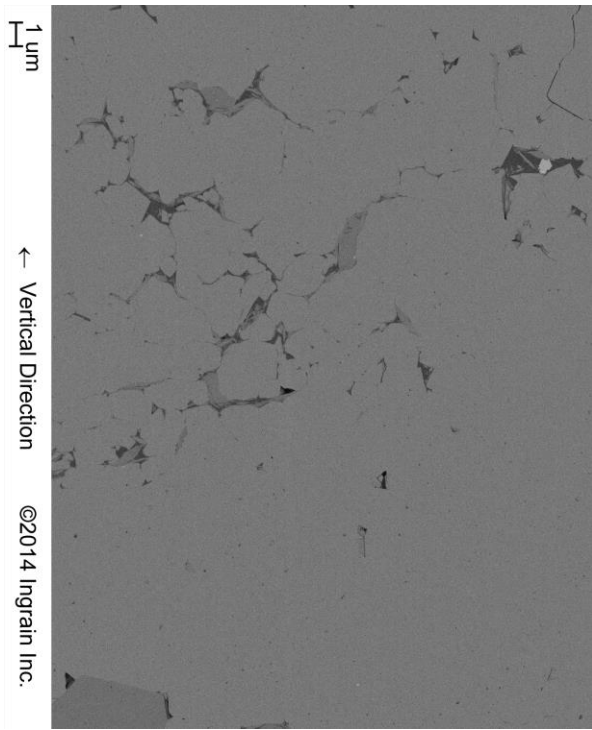
48b. 9167.95 ft., secondary



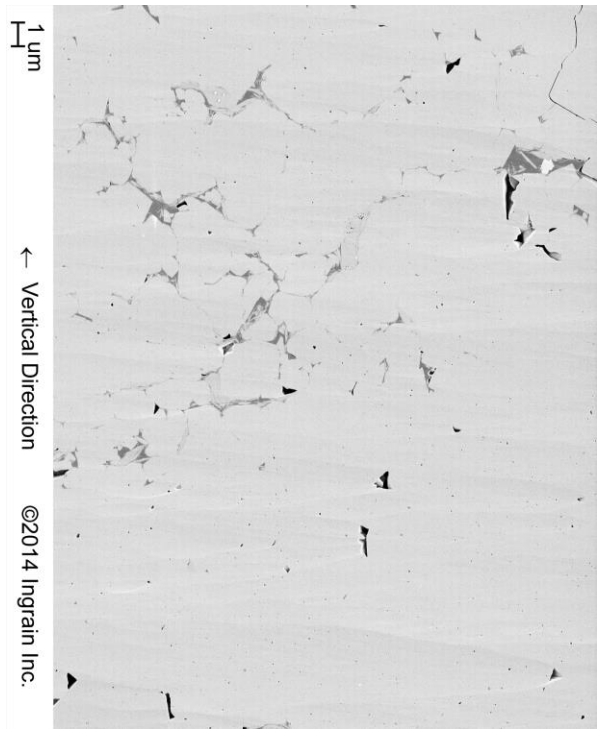
49a. 9167.95 ft., backscatter



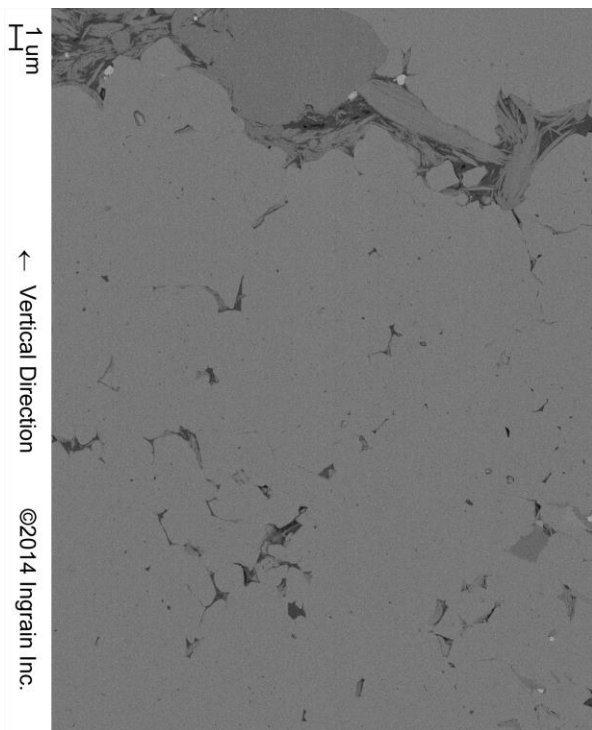
49b. 9167.95 ft., secondary



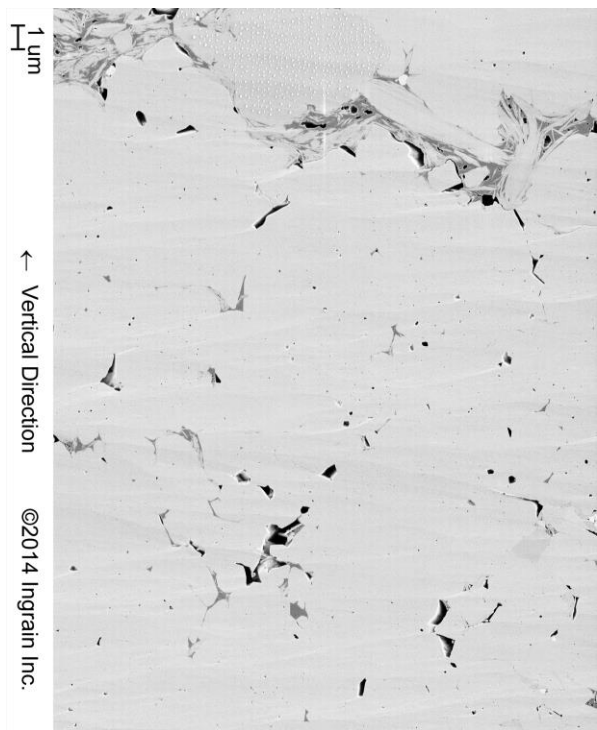
50a. 9167.95 ft., backscatter



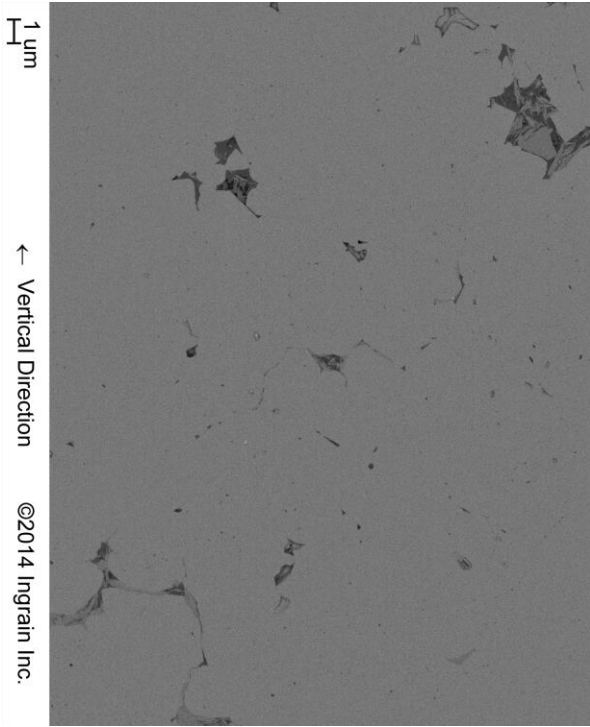
50b. 9167.95 ft., secondary



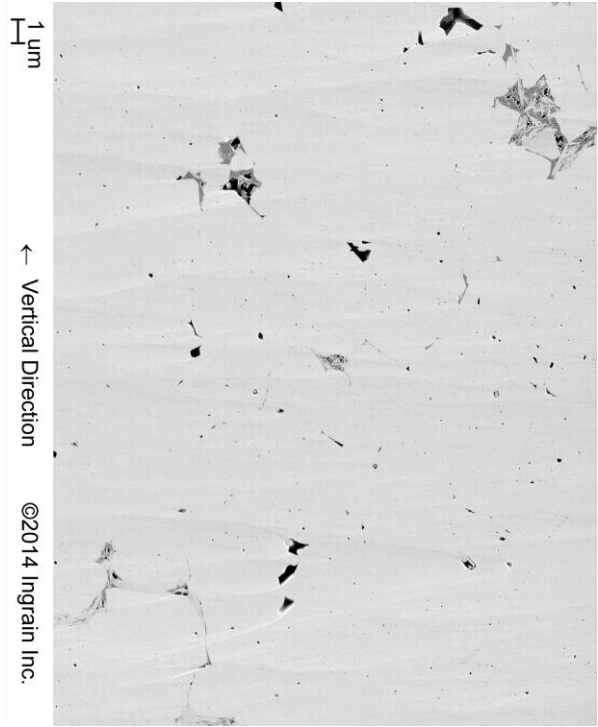
51a. 9167.95 ft., backscatter



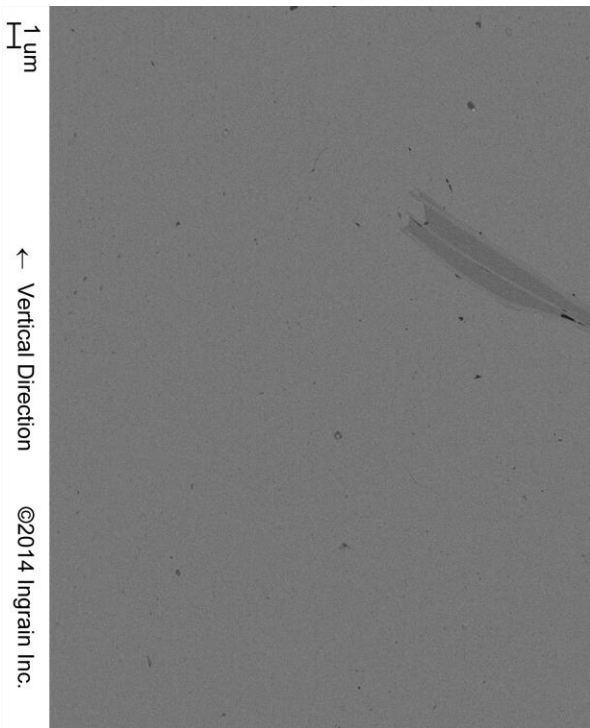
51b. 9167.95 ft., secondary



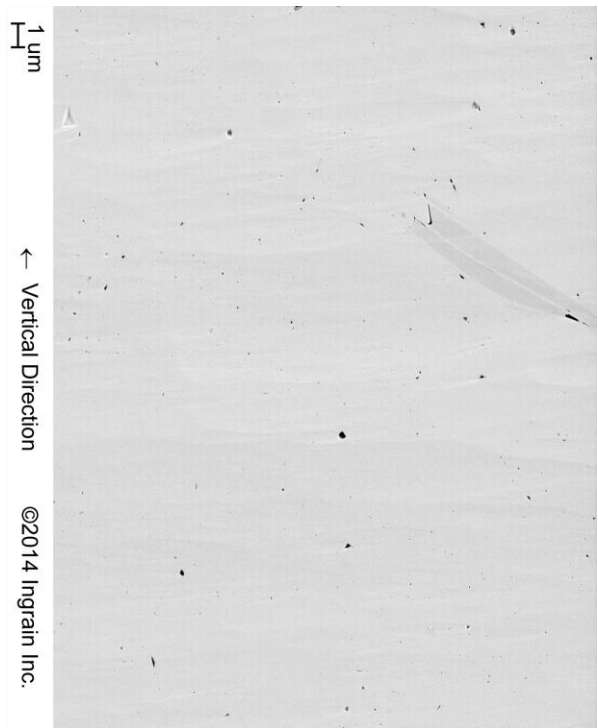
52a. 9167.95 ft., backscatter



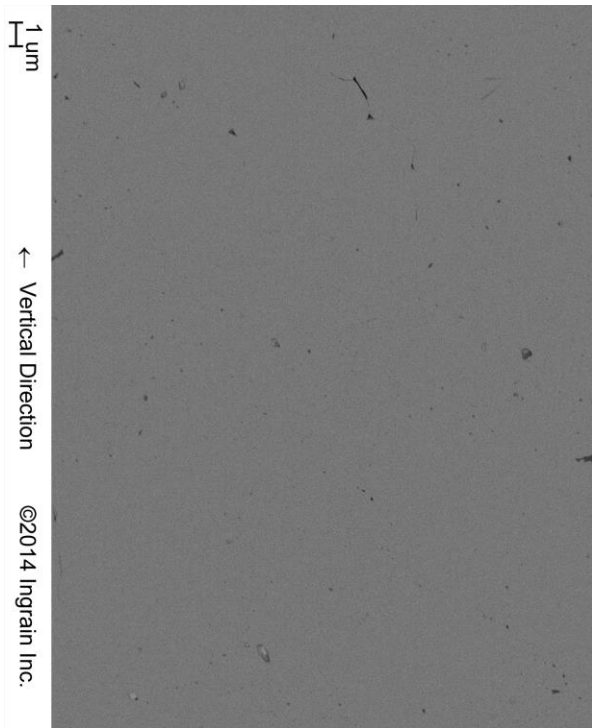
52b. 9167.95 ft., secondary



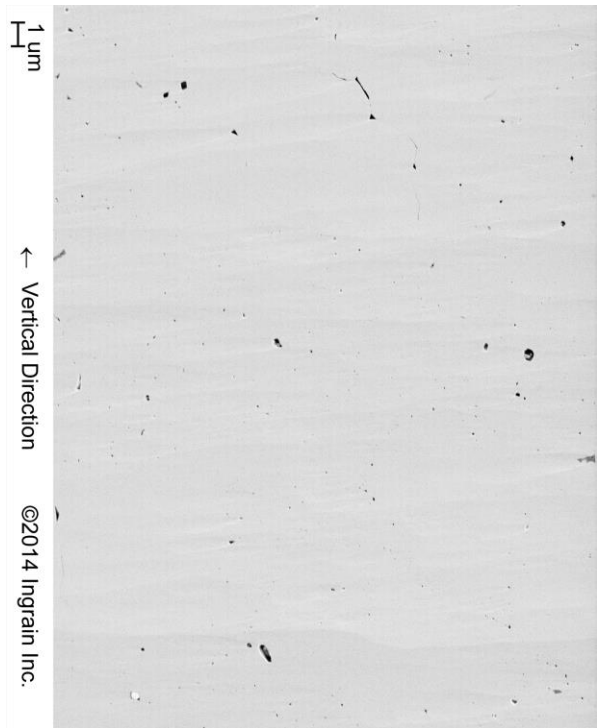
53a. 9167.95 ft., backscatter



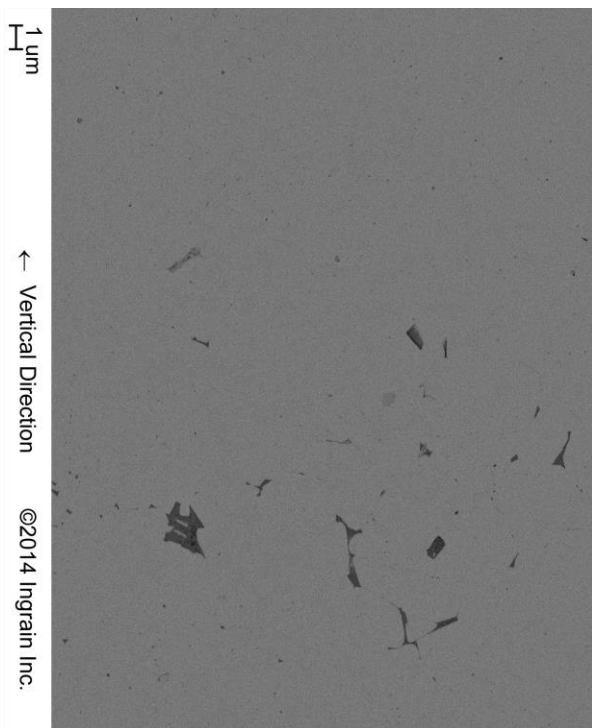
53b. 9167.95 ft., secondary



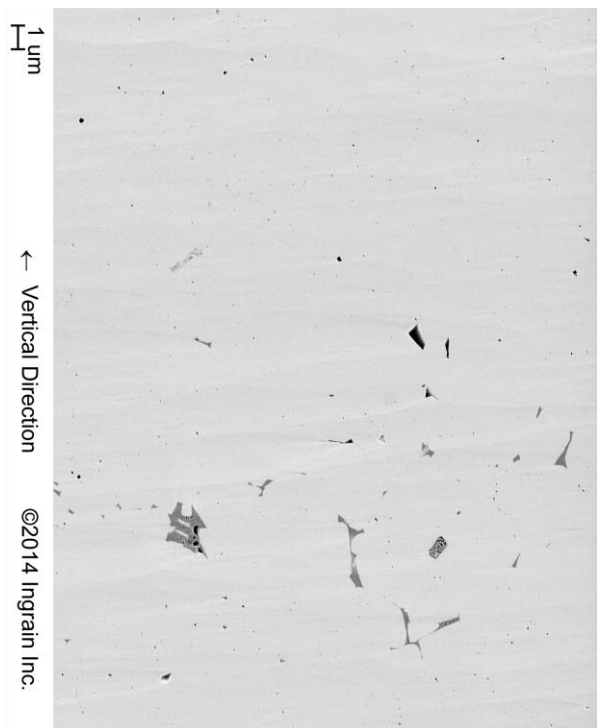
54a. 9167.95 ft., backscatter



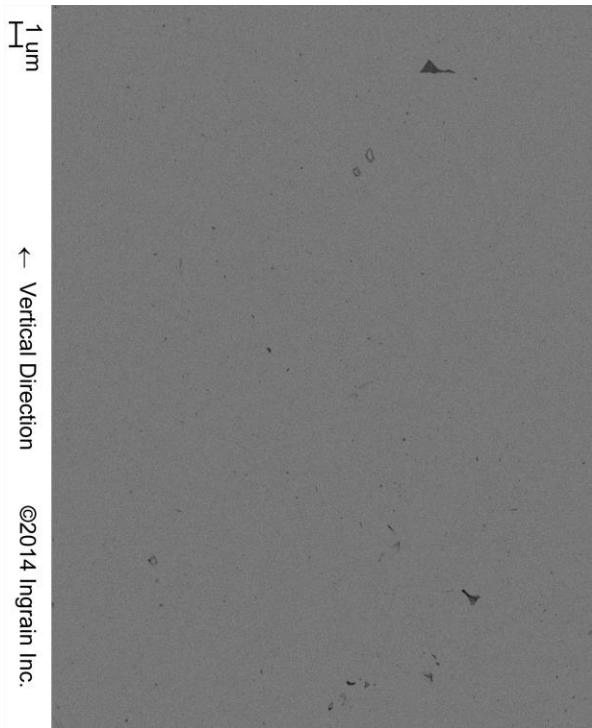
54b. 9167.95 ft., secondary



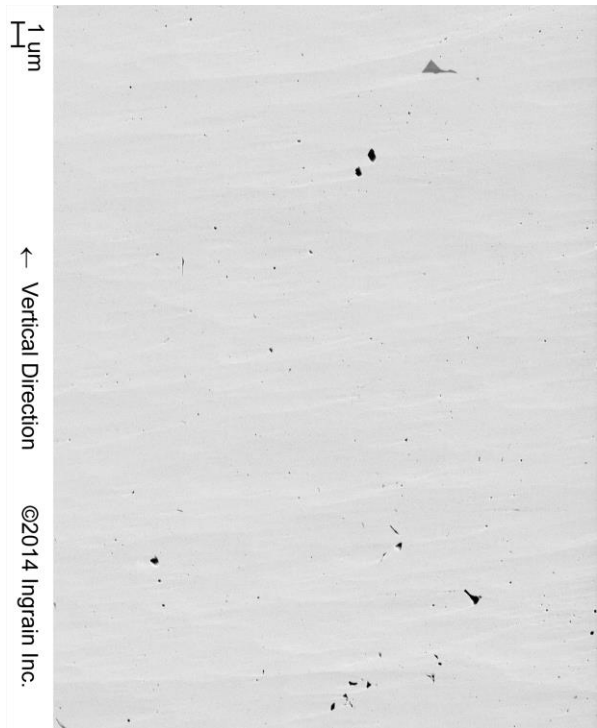
55a. 9167.95 ft., backscatter



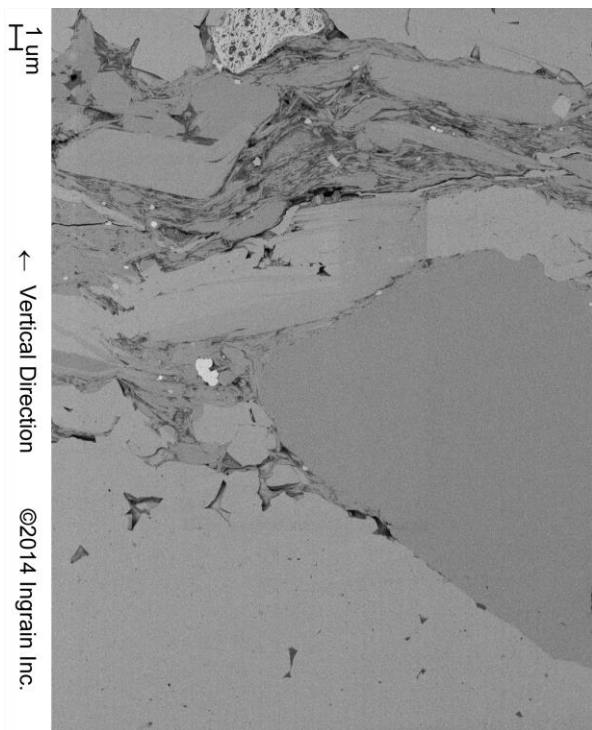
55b. 9167.95 ft., secondary



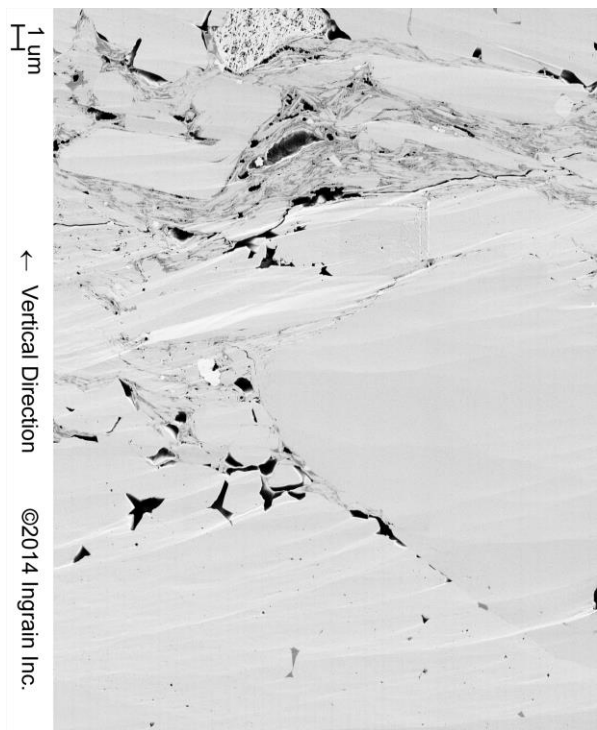
56a. 9167.95 ft., backscatter



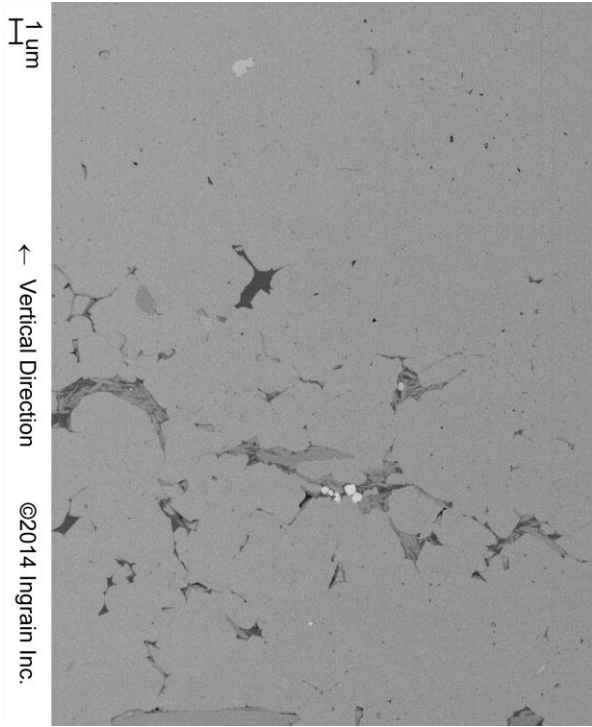
56b. 9167.95 ft., secondary



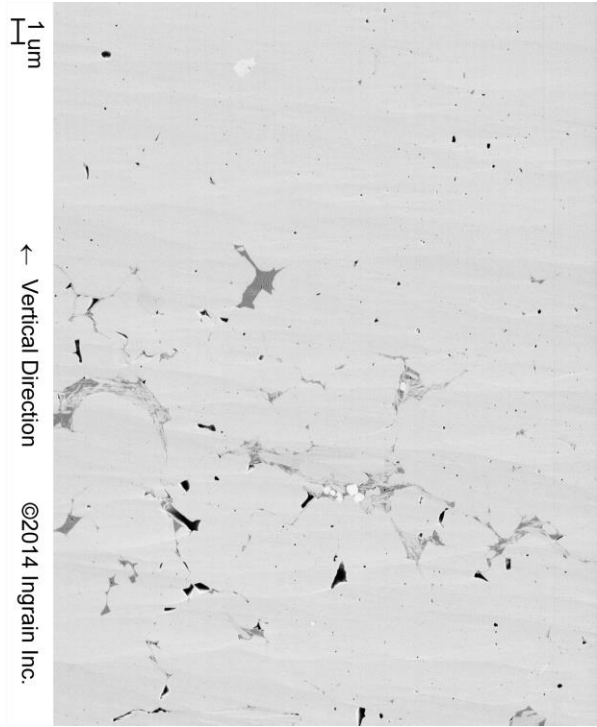
57a. 9167.95 ft., backscatter



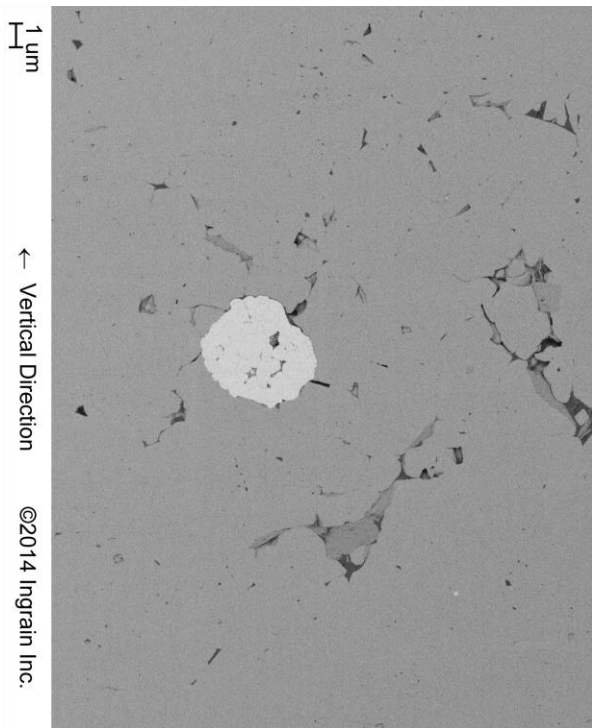
57b. 9167.95 ft., secondary



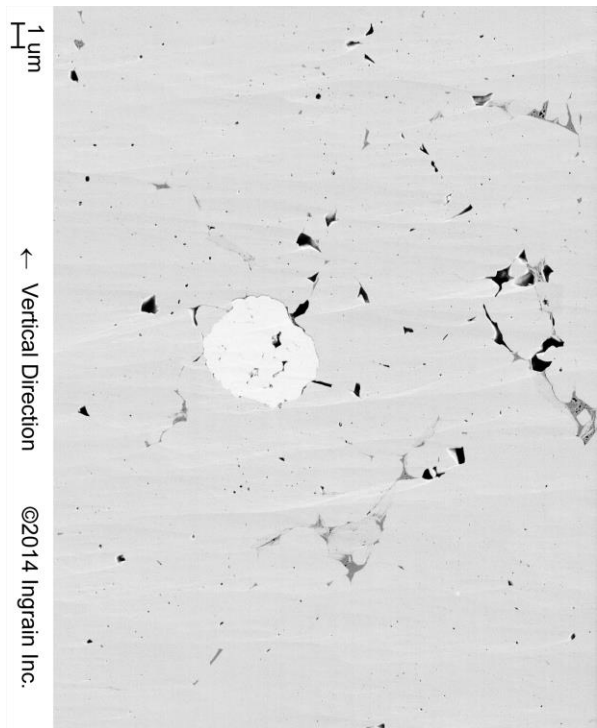
58a. 9167.95 ft., backscatter



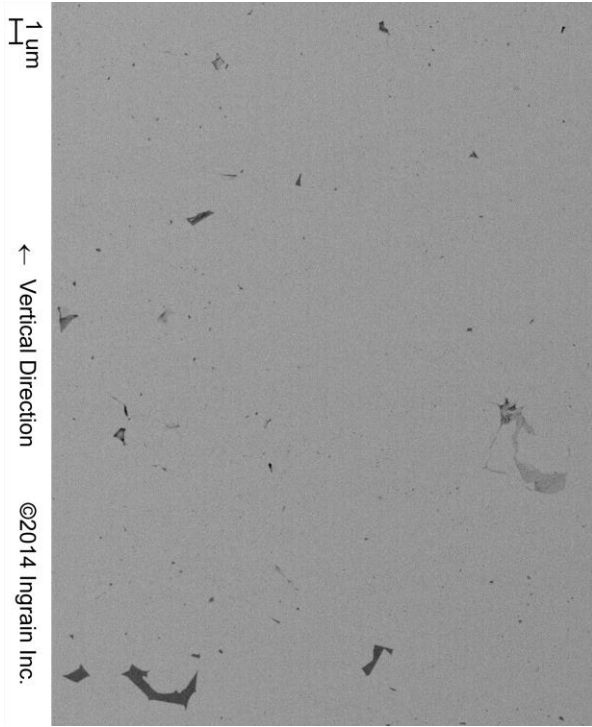
58b. 9167.95 ft., secondary



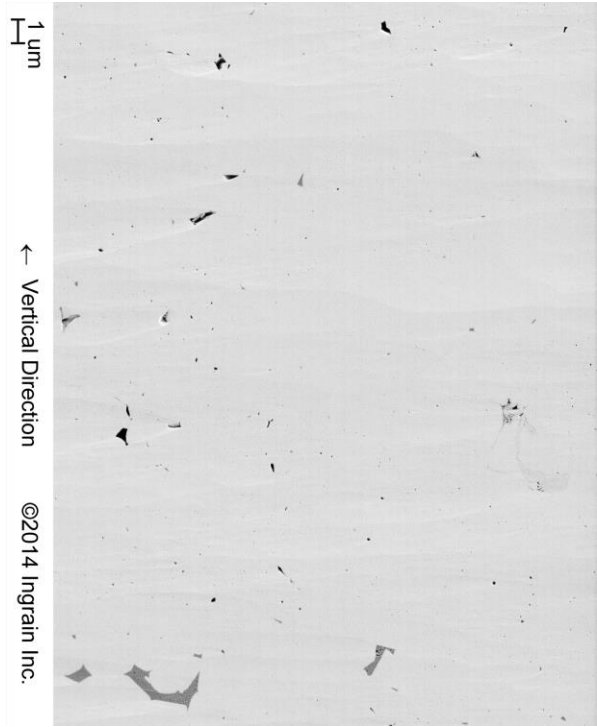
59a. 9167.95 ft., backscatter



59b. 9167.95 ft., secondary



60a. 9167.95 ft., backscatter



60b. 9167.95 ft., secondary