Thin Section Analysis Report

Sample ID:	C-01
Formation/Member Name:	Rose Run
Lithologic Classification:	Sandstone
Depth/Depth Range:	4528.8 ft
Date of Analysis:	6/1/2017
Analyzed by:	L. Ditzler

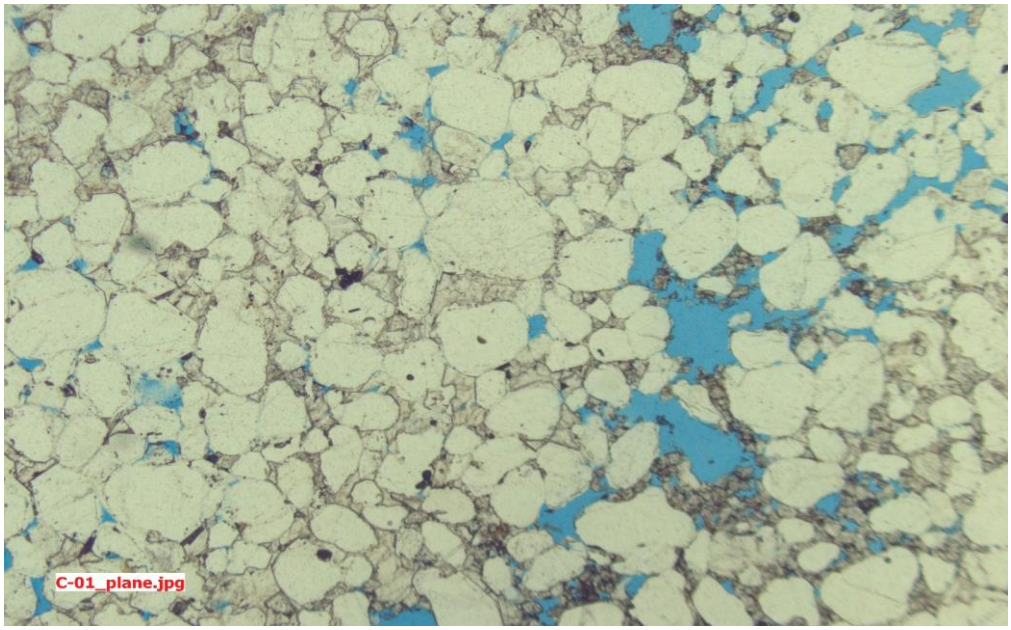
Texture		Comments
Grain Size	medium-grained, 350-500µ	
Rounding	well rounded to subrounded	
Sorting	well sorted	

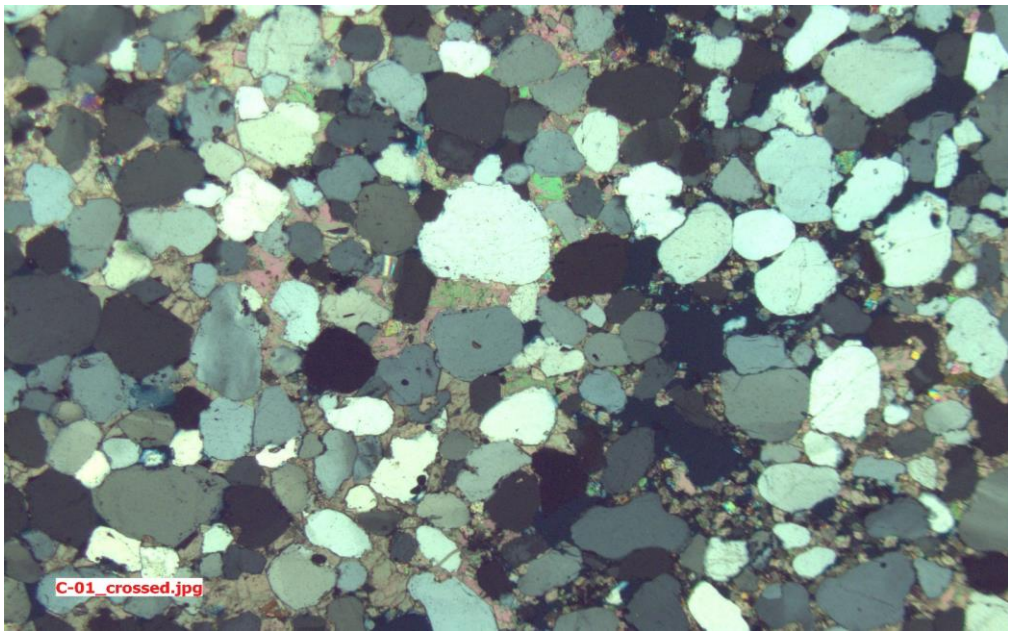
Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline	<<1%	
Monocrystalline	79%	grains sometimes with undulose extinction, some quartz overgrowths
Microcrystalline		
Feldspar		
Plagioclase		
Orthoclase		1% total microcline & plag
Microcline		
Carbonate		
Calcite	20%	interstitial cement
Dolomite		
Aragonite		
Clay		
Illite		
Smectite		
Kaolinite		
Muscovite		
Chlorite		
Glauconite		
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

Cementing Materials		Comments
Quartz	minor	
Feldspar		
Carbonate	most abundant cement, interstitial to quartz grains	
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other		

Visual Porosity Estimate	Comments
10%	pores between quartz grains

25x magnification, 5mm field of view





Thin Section Analysis Report

Sample ID:	C-02
Formation/Member Name:	Rose Run
Lithologic Classification:	Sandstone
Depth/Depth Range:	4204 ft
Date of Analysis:	6/1/2017
Analyzed by:	L. Ditzler

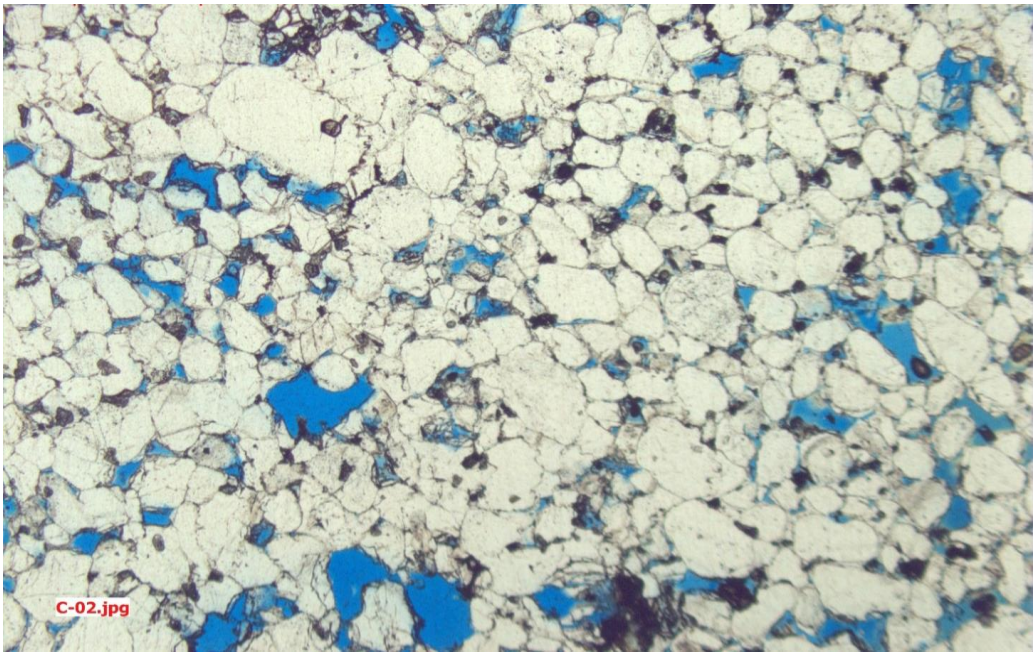
Texture		**Comments**
Grain Size	medium-grained, 350-500µ	
Rounding	rounded to subrounded	
Sorting	well sorted	

Composition/Detrital Minerals		**Comments**
Quartz		
Polycrystalline	<1%	
Monocrystalline	98%	grains sometimes with undulose extinction, quartz overgrowths
Microcrystalline		
Feldspar		
Plagioclase		
Orthoclase		1% total microcline & plag
Microcline		
Carbonate		
Calcite		
Dolomite		
Aragonite		
Clay		
Illite		
Smectite		< 1% total clays
Kaolinite		
Muscovite		
Chlorite		
Glauconite		
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

Cementing Materials		**Comments**
Quartz	overgowths on grains	well cemented
Feldspar		
Carbonate	absent	
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other		

Visual Porosity Estimate	**Comments**
15%	pores between quartz grains

25x magnification, 5mm field of view



Thin Section Analysis Report

Sample ID: C-03
Formation/Member Name: Rose Run
Lithologic Classification: Breccia
Depth/Depth Range: 6511 ft
Date of Analysis: 6/1/2017
Analyzed by: L. Ditzler/S. Shank

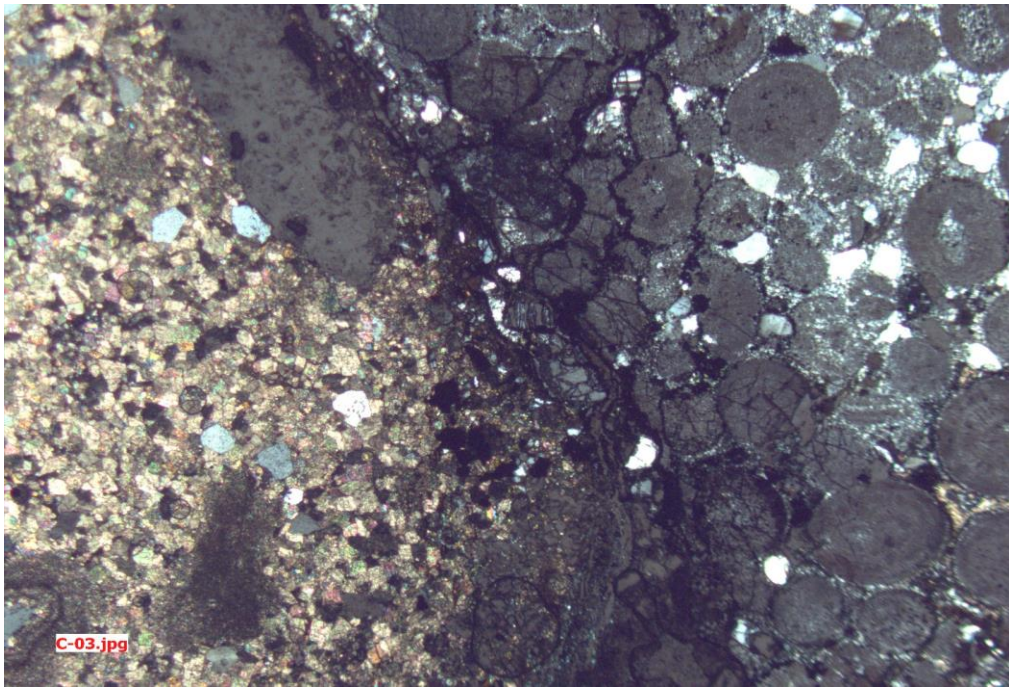
Texture		Comments
Grain Size	fragments of silicified oolites in carbonate	scattered quartz grains in carbonate - fine to medium grained, well rounded to subrounded
Rounding		
Sorting		

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		
Monocrystalline	1%	scattered grains in carbonate
Microcrystalline		
Feldspar		
Plagioclase		
Orthoclase		
Microcline		
Carbonate		
Calcite		
Dolomite	70%	fine-grained (<125 μ), recrystallized (dolomite?) with relic very fine-grained rounded oolites
Aragonite		
Clay		
Illite		
Smectite		
Kaolinite		
Muscovite		
Chlorite	<<1%	trace green in silicified oolites
Glauconite		
Rock Fragments		
Sedimentary	29%	silicified oolites in microcrytalline quartz matrix
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

Cementing Materials	Comments
Quartz	
Feldspar	
Carbonate	
Clay	
Iron Oxide, Hydoxide and/or Sulfide	
Other	

Visual Porosity Estimate	Comments
1%	thin partially open fracture and voids along silicified oolite/carbonate contact, no blue epoxy

25x magnification, 5mm field of view



Thin Section Analysis Report

Sample ID:	C-06
Formation/Member Name:	Rose Run
Lithologic Classification:	Breccia
Depth/Depth Range:	4191 ft
Date of Analysis:	6/27/2017
Analyzed by:	S. Shank

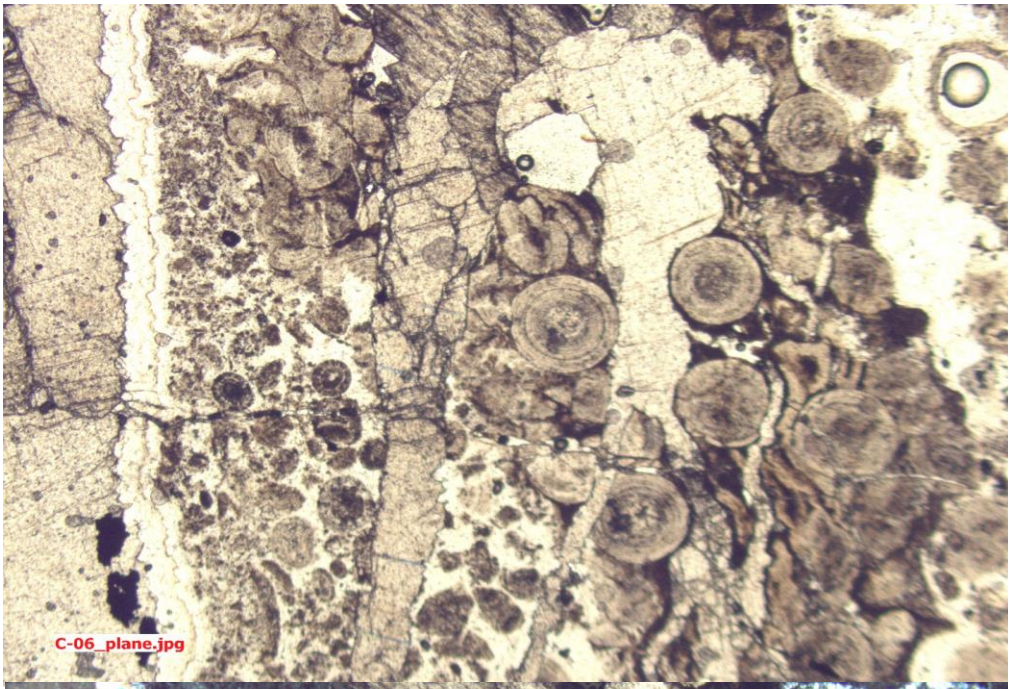
Texture		Comments
Grain Size		silicified oolites in microcrystalline quartz matrix, numerous veins of carbonate, quartz and pyrite
Rounding		
Sorting		

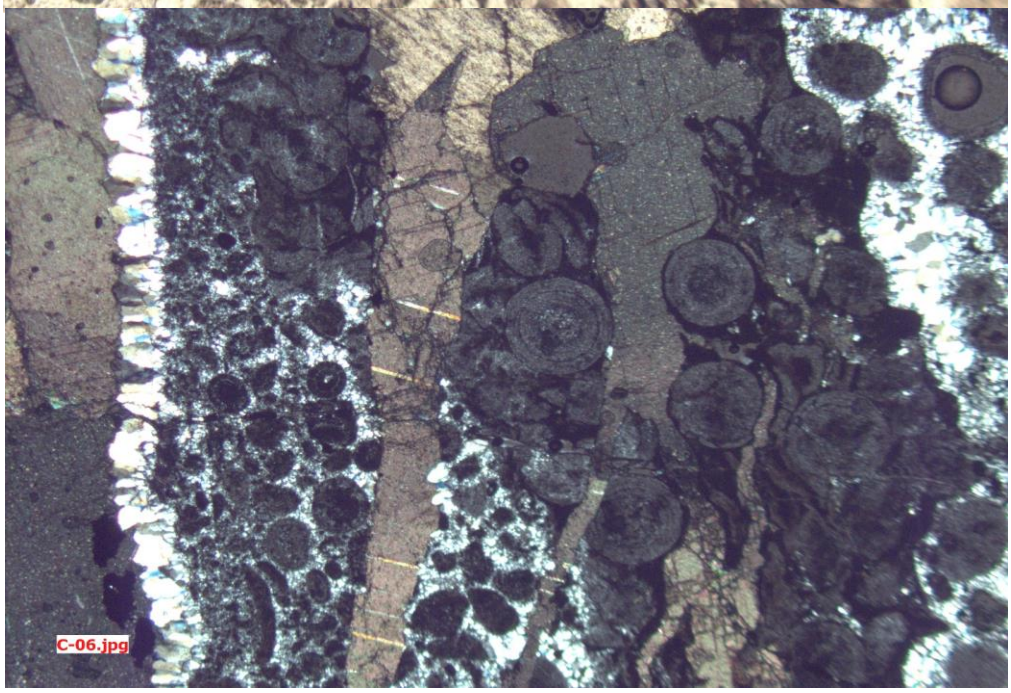
Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		
Monocrystalline		
Microcrystalline		
Feldspar		
Plagioclase		
Orthoclase		
Microcline		
Carbonate		
Calcite		
Dolomite		
Aragonite		
Clay		
Illite		
Smectite		
Kaolinite		
Muscovite		
Chlorite		
Glauconite		
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

Cementing Materials		Comments
Quartz		
Feldspar		
Carbonate		
Clay		
Iron Oxide, Hydoxide and/or Sulfide	1%	pyrite in fractures
Other		

Visual Porosity Estimate	Comments
<1%	most voids appear to be due to plucking

25x magnification, 5mm field of view





Thin Section Analysis Report

Sample ID:	C-07
Formation/Member Name:	Rose Run
Lithologic Classification:	Sandy Carbonate
Depth/Depth Range:	6500.2 ft
Date of Analysis:	6/27/2017
Analyzed by:	S. Shank

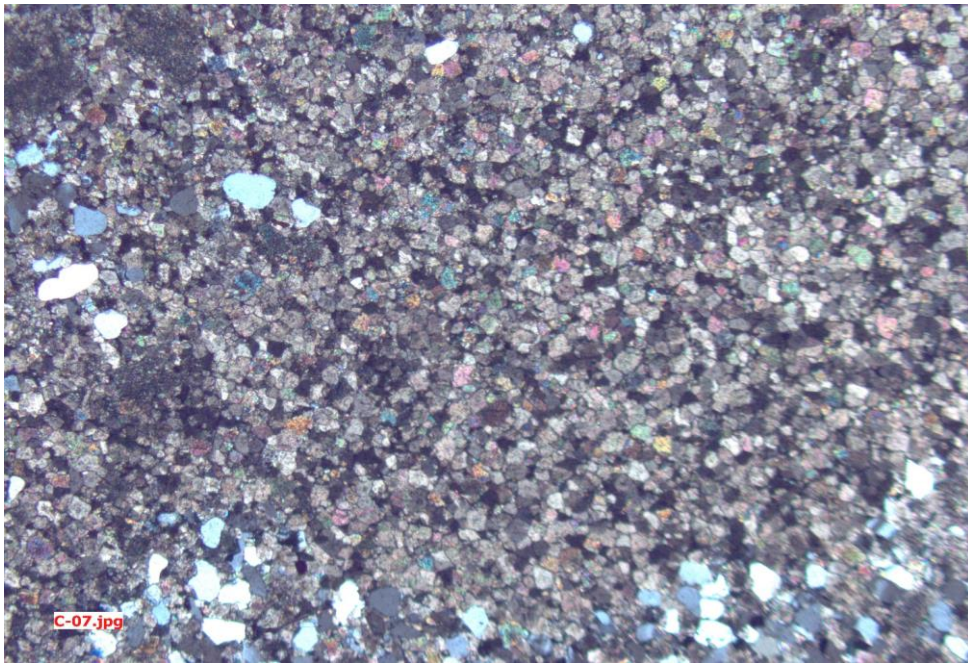
Texture		Comments
Grain Size	fine to medium	scattered quartz grains in recrystallized carbonate matrix, quartz grains locally abundant
Rounding	well-rounded to subangular	
Sorting	well sorted	

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline	<<1%	
Monocrystalline	10%	
Microcrystalline		
Feldspar		
Plagioclase		
Orthoclase		
Microcline		
Carbonate		
Calcite		
Dolomite	90%	<125µ, equant recrystallized carbonate, dolomite?
Aragonite		
Clay		
Illite		
Smectite		
Kaolinite		
Muscovite		
Chlorite		
Glauconite		
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

Cementing Materials	Comments
Quartz	
Feldspar	
Carbonate	
Clay	
Iron Oxide, Hydoxide and/or Sulfide	
Other	

Visual Porosity Estimate	Comments
<1%	voids appear to be due to plucking, no blue epoxy

25x magnification, 5mm field of view



Thin Section Analysis Report

Sample ID:	C-08
Formation/Member Name:	Rose Run
Lithologic Classification:	Carbonate
Depth/Depth Range:	6519 ft
Date of Analysis:	6/28/2017
Analyzed by:	S. Shank

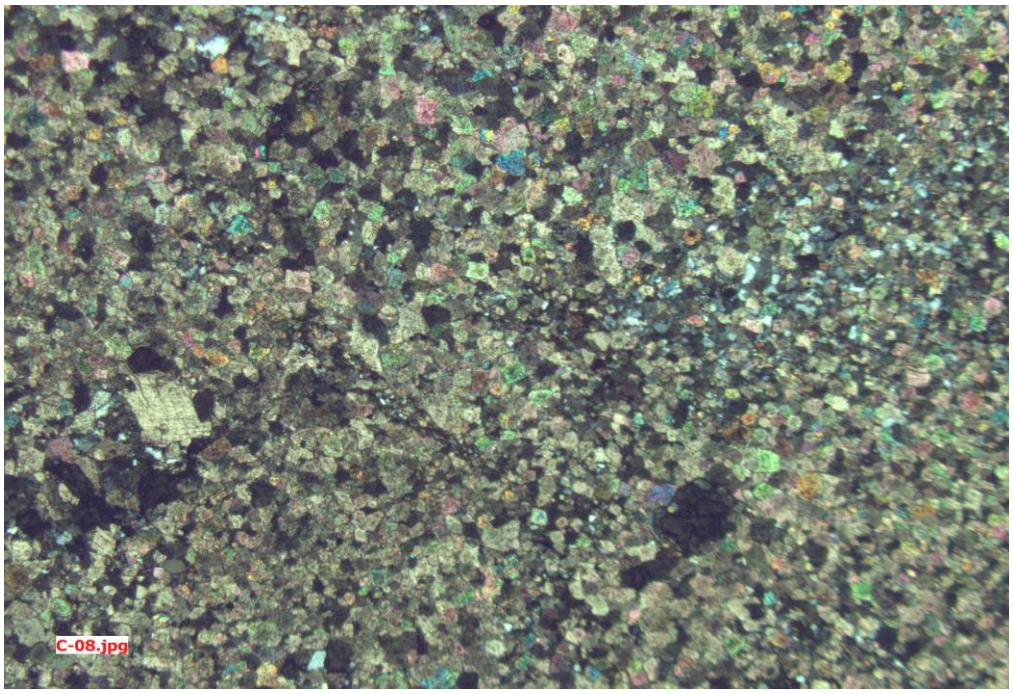
Texture		Comments
Grain Size		recrystallized carbonate with trace very fine-grained quartz
Rounding		
Sorting		

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		
Monocrystalline	<1%	trace very fine-grained quartz
Microcrystalline		
Feldspar		
Plagioclase		
Orthoclase		
Microcline		
Carbonate		
Calcite		
Dolomite	100%	equant, recrystallized carbonate, <125µ, few larger rhombs, dolomite?
Aragonite		
Clay		
Illite		
Smectite		
Kaolinite		
Muscovite		
Chlorite		
Glauconite		
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

Cementing Materials	Comments
Quartz	
Feldspar	
Carbonate	
Clay	
Iron Oxide, Hydoxide and/or Sulfide	
Other	

Visual Porosity Estimate	Comments
<<1%	voids appear to be due to plucking, no blue epoxy

25x magnification, 5mm field of view



Thin Section Analysis Report

Sample ID:	C-11
Formation/Member Name:	Rose Run
Lithologic Classification:	Sandy Carbonate
Depth/Depth Range:	4219 ft
Date of Analysis:	6/28/2017
Analyzed by:	S. Shank

Texture		Comments
Grain Size		coarsely recrystallized carbonate with trace quartz grains, really poor thin section - thin, wedged
Rounding		
Sorting		

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		
Monocrystalline	1%	scattered, very fine-grained, few larger grains
Microcrystalline		
Feldspar		
Plagioclase		
Orthoclase		
Microcline		
Carbonate		
Calcite		
Dolomite		<500µ, coarse, irregular to rhombic grains, very clouded, dolomite?
Aragonite		
Clay		
Illite		
Smectite		
Kaolinite		
Muscovite		
Chlorite		
Glauconite		
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

Cementing Materials		Comments
Quartz		
Feldspar		
Carbonate		
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other		

Visual Porosity Estimate		Comments
	5%	angular vugs with carbonate rhombs growing into void

25x magnification, 5mm field of view



Thin Section Analysis Report

Sample ID: C-13
Formation/Member Name: Rose Run
Lithologic Classification: Quartz Sandstone
Depth/Depth Range: 6484 ft
Date of Analysis: 6/28/2017
Analyzed by: S. Shank

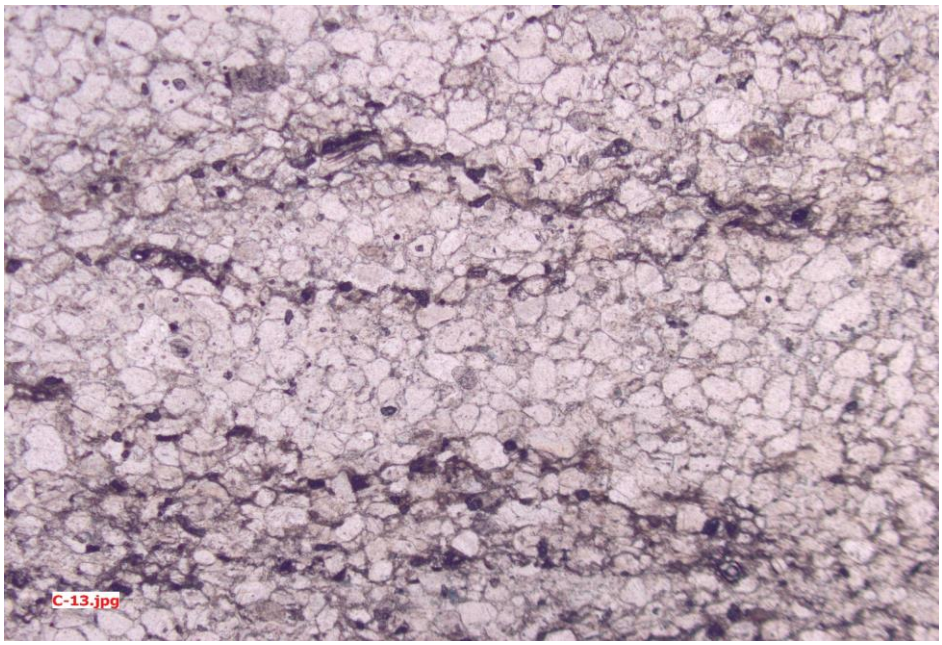
Texture		Comments
Grain Size	very fine to medium	
		some lamination based on grain size, section riddled with grit
Rounding	well to poorly rounded	
Sorting	moderately well sorted	

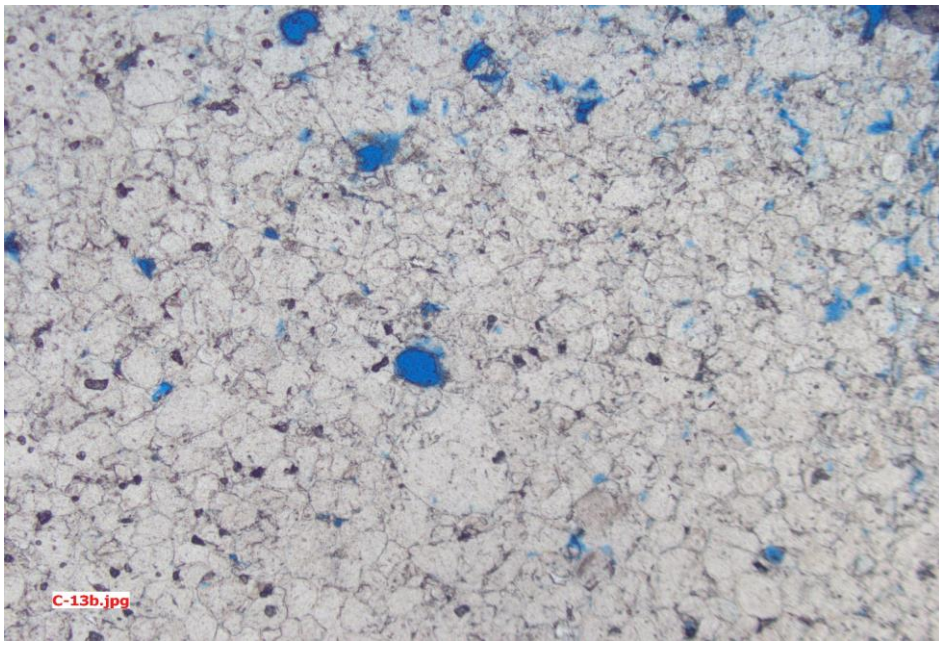
Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		
Monocrystalline	97%	some undulatory extinction
Microcrystalline		
Feldspar		
Plagioclase		
Orthoclase		
Microcline	2%	minor plagioclase
Carbonate		
Calcite		
Dolomite		
Aragonite		
Clay		
Illite		
Smectite		
Kaolinite		
Muscovite		
Chlorite		thin, irregular laminae of very fine-grained brownish green unidentified clay
Glauconite		
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

Cementing Materials		Comments
Quartz	overgrowths on quartz	well cemented
Feldspar		
Carbonate		
Clay		
Iron Oxide, Hydoxide and/or Sulfide		
Other		

Visual Porosity Estimate	Comments
3%	very irregular distribution - restricted to margins of slide, some may be plucked grains, fractures from coring?

25x magnification, 5mm field of view





Thin Section Analysis Report

Sample ID: C-14
Formation/Member Name: Rose Run
Lithologic Classification: Calcareous Sandstone
Depth/Depth Range: 4246 ft
Date of Analysis: 6/2/2017
Analyzed by: L. Ditzler

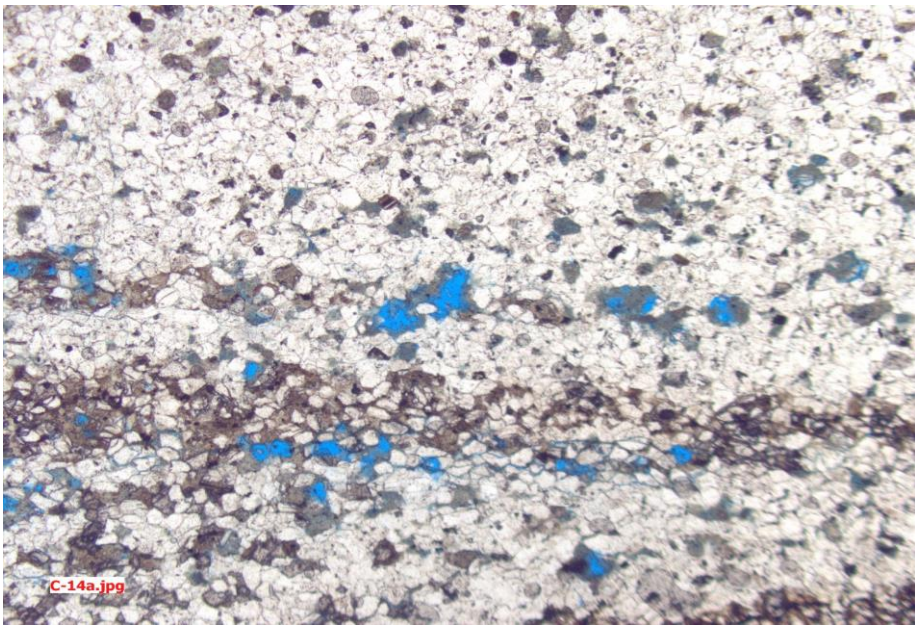
Texture		Comments
Grain Size	fine to very-fine grained, 88-125µ	well laminated based on grain size and mineralogy of coarser quartz layers, finer quartz layers with clay, clay laminae, and carbonate-rich layers
Rounding	poorly rounded	
Sorting	moderately well sorted	

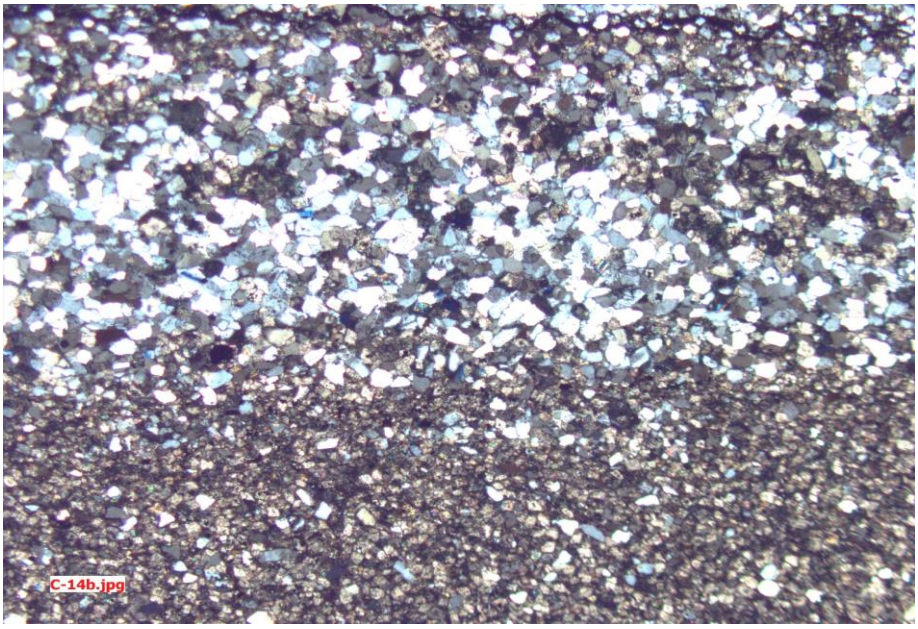
Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		
Monocrystalline	65%	
Microcrystalline		
Feldspar		
Plagioclase		
Orthoclase		
Microcline	2%	with minor plagioclase
Carbonate		
Calcite		
Dolomite		
Aragonite		
Clay		
Illite		
Smectite		
Kaolinite		
Muscovite		
Chlorite		dull green very fine grained interstitial patches with quartz layers, extremely fine-grained brownish material in thin laminae
Glauconite		
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		
	very trace opaques	

Cementing Materials		Comments
Quartz		overgrowths on quartz
Feldspar		
Carbonate		
Clay		some interstial material in quartz-rich layers
Iron Oxide, Hydoxide and/or Sulfide		
Other		

Visual Porosity Estimate	Comments
5%	highly variable, in coarser quartz rich layers - open space in clay rich laminae? and replacing greenish clay, no porosity in finer-grained quartz and carbonate layers

25x magnification, 5mm field of view





Thin Section Analysis Report

Sample ID:	C-15
Formation/Member Name:	Rose Run
Lithologic Classification:	Sandstone
Depth/Depth Range:	4243.6 ft
Date of Analysis:	6/2/2017
Analyzed by:	L. Ditzler/S. Shank

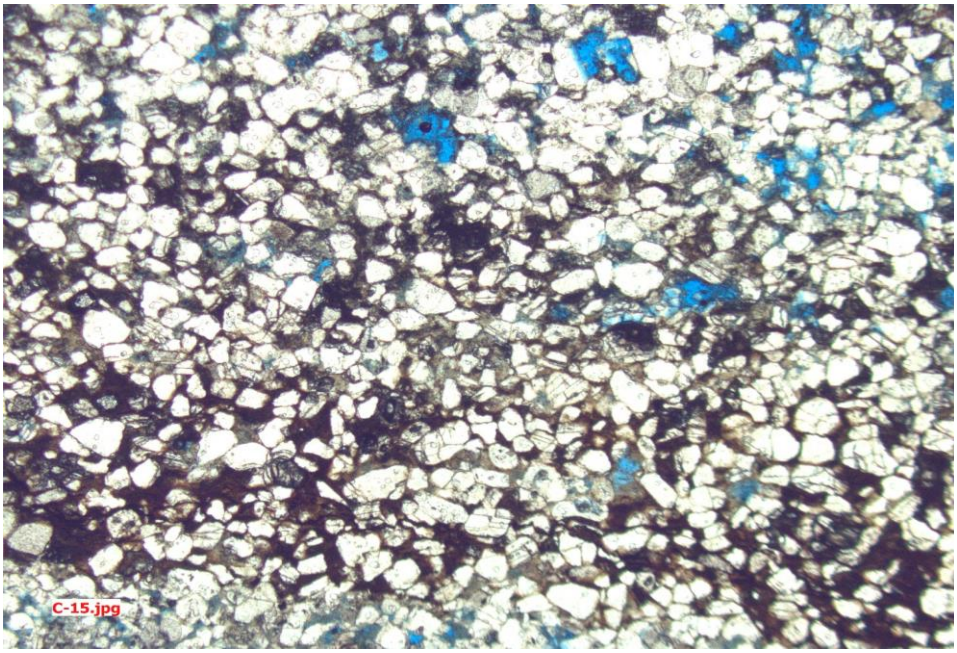
Texture		Comments
Grain Size	very fine-grained	well layered, defined by brown clay rich laminae
Rounding	well rounded to subrounded	
Sorting	well sorted	

Composition/Detrital Minerals		Comments
Quartz		
Polycrystalline		
Monocrystalline	78%	
Microcrystalline		
Feldspar		
Plagioclase	2.5	
Orthoclase		fairly feldspar rich
Microcline	2.5	
Carbonate		
Calcite		
Dolomite		
Aragonite		
Clay		
Illite		
Smectite		
Kaolinite		
Muscovite		
Chlorite	17%	alternating layers of greenish interstitial clay and brownish red interstitial (some hematite?) - Liesegang bands?
Glauconite		
Rock Fragments		
Sedimentary		
Volcanic		
Metamorphic		
Other (Accessory Minerals)		

Cementing Materials		Comments
Quartz		quartz overgrowths, well cemented
Feldspar		
Carbonate		
Clay	17%	greenish insterstitial patches and mm wide bands of brownish clay and hematite? Liesegang bands?
Iron Oxide, Hydoxide and/or Sulfide		
Other		

Visual Porosity Estimate	Comments
10%	restricted to quartz rich layers - replacing green clay but with patchy distribution, minimal porosity in red brown bands

25x magnification, 5mm field of view



Thin Section Analysis Report

Sample ID:	C-16
Formation/Member Name:	Rose Run
Lithologic Classification:	Carbonate
Depth/Depth Range:	4247 ft
Date of Analysis:	6/28/2017
Analyzed by:	S. Shank

Texture	Comments
Grain Size	
Rounding	
Sorting	

Composition/Detrital Minerals	Comments
Quartz	
Polycrystalline	
Monocrystalline	
Microcrystalline	
Feldspar	
Plagioclase	
Orthoclase	
Microcline	
Carbonate	
Calcite	
Dolomite	62-250µ, recrystallized, equigranular to rhombic grains, very cloudy, dolomite?
Aragonite	
Clay	
Illite	
Smectite	
Kaolinite	
Muscovite	
Chlorite	
Glauconite	
Rock Fragments	
Sedimentary	
Volcanic	
Metamorphic	
Other (Accessory Minerals)	

Cementing Materials	Comments
Quartz	
Feldspar	
Carbonate	
Clay	
Iron Oxide, Hydoxide and/or Sulfide	
Other	

Visual Porosity Estimate	Comments
<<1%	very scattered, small angular voids, no blue epoxy

25x magnification, 5mm field of view

