

Lower McMurray X-Ray Diffraction Analysis

Parameter	AA/06-07-077-08W4M 388.73 m MD	AA/06-07-077-08W4M 389.78 m MD	AA/06-07-077-08W4M 391.04 m MD	AA/12-06-077-08W4M 412.83 m MD	AA/12-06-077-08W4M 413.82 m MD	AA/14-18-077-08W4M 377.62 m MD	AA/16-07-077-08W4M 380.97 m MD
Total Clay % <2 microns by Volume	8.4	2.1	8.4	24.5	18.1	4.2	1.7
Glycolated Clay Fraction % <2 microns							
Kaolinite	68.1	74.1	58.2	82.8	65.0	69.7	68.6
Illite	27.0	13.4	37.2	9.4	28.6	20.1	15.0
Smectite		9.2					9.4
Chlorite	4.9	3.3	4.6	7.8	6.4	10.2	7.0
Bulk Powder + Bulk Clays % by Volume							
Quartz	83.2	95.1	81.1	66.5	71.0	93.0	94.4
K-Feldspar	1.6	1.3	2.9	3.2	2.4	1.1	1.9
Plagioclase	0.6	0.3	1.1	1.2	1.6	0.2	0.3
Siderite	4.3	0.2	3.0	0.9	1.0	0.3	
Dolomite	0.4		1.0				0.5
Pyrite			0.7	0.3	0.3	0.2	0.4
Kaolinite	5.3	1.7	4.8	20.0	12.3	2.5	1.3
Illite	2.3	0.4	2.9	3.3	5.2	1.3	0.4
Chlorite	0.8	trace	0.7	1.2	0.6	0.4	trace
Calcite	0.4	0.3	1.0	1.4	3.0	1.0	0.3
Halite		0.2			0.3		
Rutile	0.7	0.5	0.8	0.9	0.9		0.5
Anatase	0.4			1.2	1.4		
Smectite		present					present



McMurray C X-Ray Diffraction Analysis

Parameter	AA/06-07-077-08W4M 391.04 m MD	AA/07-06-077-08W4M 386.62 m MD	00/08-18-077-08W4M 327.64 m MD	00/08-18-077-08W4M 336.24 m MD	AA/08-18-077-08W4M 343.22 m MD	AA/08-18-077-08W4M 351.39 m MD	AA/08-18-077-08W4M 357.43 m MD	AA/08-18-077-08W4M 360.64 m MD	AA/08-18-077-08W4M 360.64 m MD	AA/09-01-077-09W4M 399.43 m MD	AA/09-01-077-09W4M 404.93 m MD	AA/09-05-077-08W4M 378.31 m MD	AA/09-06-077-08W4M 377.90 m MD	AA/09-06-077-08W4M 395.24 m MD	AA/09-06-077-08W4M 404.40 m MD	AA/11-06-077-08W4M 386.94 m MD	AA/09-07-077-08W4M 367.78 m MD	AA/09-07-077-08W4M 367.89 m MD	AA/09-07-077-08W4M 370.90 m MD	AA/09-07-077-08W4M 379.06 m MD	AA/09-07-077-08W4M 385.62 m MD
Total Clay % <2 microns by Volume	8.4	21.2	6.3	1.3	1.3	1.3	0.9	1.3	1.7	0.9	1.7	8.8	1.7	1.7	3.3	2.1	3.4	2.6	1.3	3.7	2.1
Glycolated Clay Fraction % <2 microns																					
Kaolinite	58.2	54.8	66.0	59.1	86.5	100.0	100.0	100.0	82.6	100.0	83.0	47.3	75.7	67.4	65.3	73.0	70.1	67.4	75.1	81.5	84.6
Illite	37.2	28.6	34.0	40.9	13.5				17.4		17.0	41.0	20.8	28.3	29.1	20.5	24.9	28.8	21.0	15.2	12.4
Smectite		1.9										3.6									
Chlorite	4.6	14.7										8.1	3.5	4.3	5.6	6.5	5.0	3.8	3.3	3.3	3.0
Bulk Powder + Bulk Clays % by Volume																					
Quartz	81.1	67.7	85.9	94.8	96.5	95.2	96.8	96.1	94.3	95.3	95.8	80.2	92.9	95.1	91.2	95.4	92.3	94.2	96.9	91.7	93.5
K-Feldspar	2.9	2.5	1.3	1.9	0.5	1.6	0.7	1.0	2.6	2.0	0.8	1.8	2.1	1.3	2.5	1.3	1.9	1.1	1.0	1.7	1.4
Plagioclase	1.1	1.3	1.3	0.5	0.2	0.5	0.2	0.3	0.3	0.3	0.3	1.4	1.3	0.3	0.8	0.5	0.3	0.6	0.2	1.1	0.5
Siderite	3.0	4.0	1.5	0.5	0.5	0.3	0.8	0.5	0.5	0.2	0.3	3.1	0.3	0.3	0.5	0.3	0.6	0.3	0.2	0.3	0.5
Dolomite	1.0		0.9	0.3	0.3	0.5	0.3	0.3	0.3	0.2	0.3	0.8	0.5	0.2	0.5		0.2	0.2		0.3	0.5
Pyrite	0.7		1.5	0.4	0.4							0.3	0.4	0.2	0.2		0.2			0.2	0.4
Kaolinite	4.8	10.8	4.3	1.3	1.3	1.3	0.9	1.3	1.7	0.9	1.3	4.4	1.3	1.3	2.5	1.7	2.1	1.7	0.9	2.9	1.7
Illite	2.9	9.5	2.0	trace	trace				trace		0.4	4.0	0.4	0.4	0.8	0.4	1.3	0.9	0.4	0.8	0.4
Chlorite	0.7	0.9										0.4	trace	trace	trace	trace	trace		trace	trace	trace
Calcite	1.0	1.0	1.0	0.3	0.3	0.6	0.3	0.5	0.3	0.2		1.2	0.5	0.2	0.3	0.2	0.5	0.4	0.2	0.5	0.5
Halite												1.0		0.2	0.1	0.2	0.2	0.1		0.2	0.1
Rutile	0.8	1.3								0.4	0.3	0.6	0.1	0.3	0.4		0.2	0.2	0.2	0.3	0.5
Anatase		1.0										0.8	0.2	0.2	0.2		0.2	0.3			
Anhydrite										0.5	0.5										
Smectite		present										present									



McMurray C X-Ray Diffraction Analysis

Parameter	AA/10-06-077-08W4M 385.62 m MD	AA/10-06-077-08W4M 395.89 m MD	AA/10-06-077-08W4M 402.04 m MD	AA/12-06-077-08W4M 391.00 m MD	AA/13-06-077-08W4M 377.73 m MD	AA/13-06-077-08W4M 386.04 m MD	AA/13-06-077-08W4M 386.04 m MD	AA/14-06-077-08W4M 376.2 m MD	AA/14-06-077-08W4M 376.13 m MD	AA/14-06-077-08W4M 387.40 m MD	AA/14-06-077-08W4M 389.58 m MD	AA/14-06-077-08W4M 389.58 m MD	AA/14-18-077-08W4M 389.58 m MD	AA/15-12-077-09W4M 376.21 m MD	AA/15-12-077-09W4M 376.21 m MD	AA/16-07-077-08W4M 344.88 m MD	AA/16-07-077-08W4M 351.39 m MD	AA/15-12-077-09W4M 376.21 m MD	AA/15-12-077-09W4M 376.21 m MD
Total Clay % <2 microns by Volume	1.3	0.9	2.1	6.0	10.7	12.1	7.0	3.3	3.1	3.0	2.1	2.5	1.7	17.0	18.0	4.8	7.2	23.0	21.0
Glycolated Clay Fraction % <2 microns																			
Kaolinite	71.5	91.7	86.4	68.5	58.7	56.7	64.4	74.0	71.4	71.8	76.1	89.8	83.8	30.0	29.0	59.8	63.1	38.0	30.0
Illite	14.7	8.3	13.6	27.3	34.9	38.1	31.6	23.1	23.3	23.6	20.3	8.3	16.2	51.0	50.0	36.1	32.5	51.0	50.0
Smectite	10.1				2.3														
Chlorite	3.7			4.2	4.1	4.0	4.0	2.9	5.3	4.6	3.6	1.9		19.0	21.0	4.1	4.4	23.0	20.0
Bulk Powder + Bulk Clays % by Volume																			
Quartz	95.4	93.6	93.9	88.2	78.6	77.9	86.0	92.8	94.5	93.5	95.4	93.4	95.3	74.0	73.0	88.2	88.5	69.0	71.0
K-Feldspar	1.8	3.2	2.4	1.8	2.0	2.4	1.6	2.1	1.0	1.9	1.0	1.9	2.0	3.0	5.0	1.8	1.8	4.0	4.0
Plagioclase	0.2	0.3	0.3	1.4	1.6	2.3	1.9	0.3	0.5	0.5	0.7	0.3	0.3	2.0	2.0	1.1	0.8	2.0	2.0
Siderite	0.2	0.2	0.2	0.5	4.0	2.7	1.3	0.3	0.3	0.3	0.3	0.3	0.2	3.0	1.0	0.6	0.5	1.0	1.0
Dolomite	0.5	0.6	0.3					0.3			0.3					0.6	0.5		
Pyrite		0.4		0.4				0.4	0.2	0.4		0.4	0.2	1.0	1.0	0.9		1.0	1.0
Kaolinite	0.9	0.9	1.7	3.6	5.4	6.4		2.5	2.2	2.1	1.7	2.1	1.3	5.1	4.9	2.4	4.4	8.7	6.3
Illite	0.4	trace	0.4	1.6	4.6	5.0	2.3	0.8	0.9	0.9	0.4	0.4	0.4	8.7	8.5	2.0	2.4	11.7	10.5
Chlorite	trace			0.8	0.7	0.7	0.4	trace	trace	trace	trace	trace		3.2	3.6	0.4	0.4	5.3	4.2
Calcite	0.4	0.5	0.4	0.9	1.1	1.2	0.9					0.8	0.3			1.1	0.3		
Halite				0.2	0.5	0.6													
Rutile	0.2	0.3	0.4	0.2	0.9	0.4	0.6	0.5	0.4	0.4	0.2	0.4				0.6	0.4		
Anatase				0.4	0.6	0.4	0.4									0.3			
Anhydrite																			
Smectite	present																		



McMurray A Shale X-Ray Diffraction Analysis

Parameter	AA/01-18-077-08W4M 323.35 m MD	AA/06-05-077-08W4M 375.84 m MD	AA/06-06-077-08W4M 376.87 m MD	AA/06-07-077-08W4M 351.95 m MD	AA/09-01-077-09W4M 381.21 m MD	AA/09-05-077-08W4M 370.85 m MD	AA/09-06-077-08W4M 368.9 m MD	AA/09-07-077-08W4M 351.01 m MD	AA/10-06-077-08W4M 365.90 m MD	AA/12-06-077-08W4M 369.38 m MD	AA/14-06-077-08W4M 366.00 m MD	AA/16-07-077-08W4M 338.85 m MD
Total Clay % <2 microns by Volume	9.4	16.3	10.4	13.4	8.7	9.5	15.9	11.2	14.3	17.9	5.2	26.5
Glycolated Clay Fraction % <2 microns												
Kaolinite	66.1	54.1	61.6	58.2	54.2	53.4	57.2	56.5	56.5	65.9	56.6	58.0
Illite	33.9	39.8	35.1	36.1	41.8	35.4	39.5	40.6	38.9	30.3	29.4	37.3
Smectite	-	-	-	-	-	0.4	-	-	-	-	1.8	0.6
Chlorite	-	-	3.3	5.7	4.0	6.9	3.3	2.9	4.6	3.8	3.2	4.1
Bulk Powder + Bulk Clays % by Volume												
Quartz	82.3	74.4	76.0	75.1	83.2	80.5	75.7	82.4	76.6	72.3	87.9	63.3
K-Feldspar	1.4	1.7	1.8	2.4	1.4	2.3	1.7	1.1	1.8	1.7	1.8	2.3
Plagioclase	0.8	1.7	3.1	2.2	1.4	1.3	1.6	1.4	1.9	1.9	2.2	1.6
Siderite	1.0	0.8	3.0	1.3	0.7	1.0	1.4	0.8	0.9	1.5	0.6	0.8
Dolomite	0.7	0.8	1.9	0.8	0.6	0.8	0.8	-	0.5	0.4	0.4	1.1
Pyrite	0.5	1.0	-	0.8	0.5	0.3	0.5	0.4	0.7	0.3	0.4	0.7
Kaolinite	5.7	8.1	6.6	6.5	4.9	5.1	9.0	6.0	7.7	10.6	3.2	14.1
Illite	3.7	7.5	3.8	5.5	3.8	4.0	6.2	5.2	5.9	6.6	1.6	12.1
Chlorite		0.7	trace	1.4	trace	-	0.7	trace	0.7	0.7	0.4	0.3
Calcite	2.2	1.7	2.2	3.3	2.8	2.1	0.5	1.1	1.3	1.9	0.4	2.1
Halite	-	-	-	-	-	-	-	-	-	0.3	0.2	-
Rutile	0.7	0.8	0.8	0.9	0.8	1.0	1.0	0.7	0.7	0.5	0.4	0.7
Anatase	1.0	0.8	0.8	1.2	0.9	0.7	0.9	0.9	1.3	1.3	0.5	0.9
Smectite	-	-	-	-	-	present	-	-	-	-	present	present

McMurray A Sand X-Ray Diffraction Analysis

Parameter	00/08-18-077-08W4M 3318.65 m MD	AA/10-06-077-08W4M 364.20 m MD	AA/14-06-077-08W4M 376.87 m MD
Total Clay % <2 microns by Volume	1.7	3.8	13.2
Glycolated Clay Fraction % <2 microns			
Kaolinite	66.5	64.1	56.3
Illite	33.5	32.2	36.3
Smectite			1.9
Chlorite		3.7	5.5
Bulk Powder + Bulk Clays % by Volume			
Quartz	93.9	91.4	76.6
K-Feldspar	1.3	2.2	2.0
Plagioclase	1.6	0.6	2.5
Siderite	0.3	0.3	1.2
Dolomite	0.5	0.3	0.9
Pyrite	0.4	0.2	1.0
Kaolinite	1.3	2.1	7.0
Illite	0.4	1.7	5.2
Chlorite		trace	1.0
Calcite	0.3	0.5	0.8
Halite			0.4
Rutile		0.4	0.8
Anatase		0.3	0.6
Smectite			present



Wabiskaw C X-Ray Diffraction Analysis

Parameter	AA/01-18-077-08W4M 314.72 m MD	AA/06-05-077-08W4M 366.78 m MD	AA/06-07-077-08W4M 342.25 m MD	AA/09-05-077-08W4M 360.41 m MD	AA/10-06-077-08W4M 356.22 m MD	AA/14-06-077-08W4M 355.33 m MD	AA/16-07-077-08W4M 329.99 m MD
Total Clay % <2 microns by Volume	8.0	7.2	7.5	4.0	6.9	9.7	8.4
Glycolated Clay Fraction % <2 microns							
Kaolinite	57.0	49.4	46.7	49.8	61.3	53.0	55.2
Illite	33.7	37.7	35.7	32.7	30.6	35.9	35.8
Smectite	2.8	6.0	11.1	13.0	2.6	3.8	2.3
Chlorite	6.5	6.9	6.5	4.5	5.5	7.3	6.7
Bulk Powder + Bulk Clays % by Volume							
Quartz	70.4	74.7	83.4	87.2	84.7	74.1	80.0
K-Feldspar	3.8	4.1	2.0	1.8	2.6	4.0	1.9
Plagioclase	3.0	3.4	2.0	3.3	2.3	2.3	2.0
Siderite	2.2	4.1	0.9	0.4	0.6	0.6	1.5
Dolomite	7.2	3.7	0.9	0.7	0.9	5.0	3.5
Pyrite	1.9	1.1	1.2	0.9	0.9	2.4	0.9
Kaolinite	4.8	3.4	3.4	2.0	3.8	4.7	4.7
Illite	3.2	3.1	3.0	1.6	2.3	4.0	3.3
Chlorite	trace	0.7	1.1	0.4	0.8	1.0	0.4
Calcite	1.3	0.6	0.7	0.6	0.4	0.6	1.1
Halite			0.3	0.2		0.2	
Rutile	1.3	0.5	0.5	0.4	0.3	0.6	0.4
Anatase	0.9	0.6	0.6	0.5	0.4	0.5	0.3
Smectite	present	present	present	present	present	present	present



Clearwater Caprock X-Ray Diffraction Analysis

Parameter	00/08-18-077-08W4M 306.52 m MD	00/08-18-077-08W4M 304.97 m MD	AA/01-18-077-08W4M 310.60 m MD	AA/06-05-077-08W4M 363.65 m MD	AA/09-01-077-09W4M 368.57 m MD	AA/09-05-077-08W4M 359.30 m MD	AA/10-06-077-08W4M 353.46 m MD	AA/14-06-077-08W4M 354.40 m MD	AA/16.07-077-08W4M 326.23 m MD
Total Clay % <2 microns by Volume	15.6	10.1	12.1	17.5	16.5	22.1	23.3	24.5	18.3
Glycolated Clay Fraction % <2 microns									
Kaolinite	51.9	9.6	49.4	29.4	32.7	26.9	30.2	28.1	31.3
Illite	37.6	47.1	34.8	57.2	40.2	30.4	29.7	29.5	50.7
Smectite	10.5	6.4	-	-	-	36.8	17.9	26.3	3.7
Chlorite	-	36.9	15.8	13.4	27.1	5.9	22.2	16.1	14.3
Bulk Powder + Bulk Clays % by Volume									
Quartz	65.9	58.5	65.2	62.0	60.7	51.4	53.6	56.8	63.1
K-Feldspar	4.8	5.5	3.6	4.1	3.2	5.8	4.5	4.4	4.7
Plagioclase	5.1	6.1	4.1	5.5	7.6	7.4	5.7	6.8	2.9
Siderite	1.7	1.5	4.3	1.4	2.0	1.9	2.5	1.5	1.4
Dolomite	3.4	15.2	3.0	2.4	2.6	2.1	3.4	1.5	1.5
Pyrite	1.7	2.1	1.2	1.5	2.5	2.4	1.0	1.1	2.0
Kaolinite	6.0	1.3	5.6	6.2	6.6	7.9	10.0	9.0	6.0
Illite	9.6	4.5	4.7	9.9	8.0	12.8	9.7	12.7	10.3
Chlorite	-	2.7	1.8	1.4	1.9	1.4	3.6	2.8	2.0
Calcite	1.8	1.0	2.2	2.6	1.6	2.8	2.8	0.6	3.0
Rectorite	-	1.6	-	-	-	-	-	-	-
Halite	-	-	1.3	-	0.6	0.9	-	0.6	-
Rutile	-	-	1.2	1.7	1.5	1.8	1.8	1.3	1.8
Anatase	-	-	1.8	1.3	1.2	1.4	1.4	0.9	1.3
Smectite	Present	Present	-	-	-	Present	Present	Present	Present

