

# Geological Report

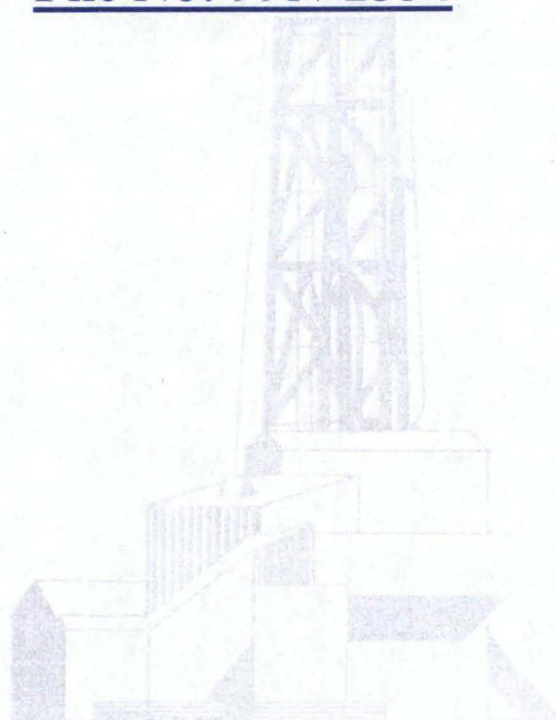
N.E.B. COPY

RECEIVED  
SUR MOUNTAIN

*PARAMOUNT  
ET AL LIARD A-01*

60° 00' 05" 123° 15' 05"

File No: 99N-2334



**C L Consultants  
Limited**

***PARAMOUNT  
ET AL LIARD A-01***

**60° 00' 05" 123° 15' 05"**

**File No: 99N-2334**

Prepared by:

**BARRY CLATTENBURG**

Staff Wellsite Geologist  
CL Consultants Limited

Prepared for:

Paul Collens

**PARAMOUNT RESOURCES LIMITED**

PERMIT TO PRACTICE  
CL CONSULTANTS LIMITED

Signature: 

Date: March 26, 1999

PERMIT NUMBER: P 2911

The Association of Professional Engineers,  
Geologists and Geophysicists of Alberta



**CL Consultants  
Limited**



INDEX

<u>Subject</u>	<u>Page Number</u>
SYNOPSIS	2
FORMATION TOPS (m)	4
DEVIATION SURVEY RECORD	5
BIT RECORD	6
DAILY DRILLING CHRONOLOGY	7
DRILLSTEM TEST 1	15
DRILLSTEM TEST 2	17
DRILLSTEM TEST 3	18
DRILLSTEM TEST 4	20
DRILLSTEM TEST 5	21
DRILLSTEM TEST 6	22
DRILLSTEM TEST 7	24
DRILLSTEM TEST 8	25
DRILLSTEM TEST 9	26
DETAILED CORE DESCRIPTION	27
LITHOLOGY	28
GEOLOGICAL SUMMARY AND CONCLUSIONS	84
SUMMARY OF DRILLING BREAKS AND GAS INCREASES	91

### SYNOPSIS

**OPERATOR:** Paramount Resources Ltd.

**WELL NAME:** Paramount et al Liard A-01

**LOCATION:** 60° 00' 05" 123° 15' 05"

**FIELD:** Undefined

**PROVINCE:** Northwest Territories

**ELEVATIONS:** G.L. 517.15m K.B. 522.65m

**SPUD DATE:** February 09, 1999 05:30 hrs.

**T.D. DATE:** March 19, 1999 20:20 hrs.

**CONTRACTOR:** Precision Drilling Ltd. Rig: 373

**HOLE SIZE:** 222mm

**COLLARS:** 218mm/165mm

**MUD COMPANY:** Baker Hughes Inteq

**MUD TYPE:** Gel Chem/Invert

**WIRELINE LOGGING CO.:** Baker Atlas

**LOG RECORD:** Run #1

1) HDIL-GR	1928.1m - 502.0m
2) ZDL-CNL-GR-XYCAL	1929.2m - 502.0m
3) MAC-GR-CAL	1923.4m - 502.0m

Run #2

1) HDIL-GR	2042.3m - 1925.0m
2) ZDL-CNL-GR-XYCAL	2043.7m - 1925.0m
3) MAC-GR-CAL	2041.2m - 1925.0m

**TESTING COMPANY:** Baker Oil Tool/Delta P Test Corp



**SYNOPSIS (cont.)**

**TEST RECORD:**

1)	1906m - 1917m	(Mattson)
2)	1865m - 1992m	(Mattson)
3)	1819m - 1848m	(Mattson)
4)	1781m - 1804.4m	(Mattson)
5)	1405m - 1429m	(Chinkeh)
6)	1638m - 1698m	(Fantasque)
7)	2028m - 2046m	(Mattson)
8)	1955m - 1965m MR	(Mattson)
9)	1955m - 1965m MR	(Mattson)

**DRILLING SUPERVISION:** Dennis McCulloch

**GEOLOGICAL SUPERVISION:** Barry C. Clattenburg

**TOTAL DEPTH:**

Driller:	2046.0 metres
Logger:	2044.8 metres

FORMATION TOPS (m)

PERIOD GROUP FORMATION (LOCAL UNITS)	PROGNOSIS		SAMPLES	LOGS	
	(subsea)	(KB)	(driller)	(KB)	(subsea)
<u>Lower Cretaceous</u>					
Lepine					
Scatter	- 448	971	1105	1099	- 576
Garbutt	- 584	1107	1236	1235	- 712
Chinkeh	- 770	1293	1410	1407	- 884
<u>Triassic</u>	- 781	1304	1455?	1447?	- 924
<u>Permian</u>					
Belloy	- 918	1441	1515	1517	- 994
Fantasque	- 956	1479	1584	1571	-1048
Mattson	-1072	1595	1721	1721	-1198
<u>Mississippian</u>					
Flett	-1807	2330			
T.D.	-1827	2350	2046	2045	-1522



DEVIATION SURVEY RECORD

Depth (m)	Deviation	Azimuth	Depth (m)	Deviation	Azimuth
40 (311mm)	0.06		1571	1.50	
68	0.25		1619	2.25	
95	0.88		1648	3.50	
125	0.25		517 (UGC)	1.30	286.1
153	0.25		646	1.20	263.7
182	0.25		788	1.00	274.7
211	1.00		925	0.80	282.0
228	0.75		1061	1.00	266.7
258	0.75		1182	1.30	281.9
288	0.50		1318	1.90	286.1
316	0.88		1451	1.10	283.0
343	0.75		1587	1.70	328.9
372	1.00		1638	3.20	318.1
401	0.25		1644	2.90	318.0
430	0.25		1653	3.50	319.8
460	1.00		1653	3.80	322.3
488	0.88		1673	4.10	319.3
95 (445mm)	0.25		1682	4.00	312.9
153	0.25		1692	3.70	306.4
211	0.13		1701	3.30	303.2
316	0.50		1711	2.80	299.3
380	0.25		1721	2.50	296.5
430	0.75		1731	2.40	296.1
530 (222mm)	1.25		1740	2.50	294.0
575	1.25		1749	2.60	294.5
625	1.25		1759	2.80	295.0
671	Misrun		1768	2.90	295.5
680	1.50		1775	3.00	295.7
728	1.00		1788	2.70	290.8
785	1.25		1798	2.60	281.0
835	0.75		1807	2.70	276.0
890	1.00		1817	3.10	273.4
939	1.00		1827	3.40	273.7
997	1.00		1836	3.60	273.3
1044	1.00		1846	3.40	272.9
1092	1.50		1855	3.30	271.0
1149	1.31		1865	3.20	271.8
1198	1.50		1874	3.00	272.2
1255	1.50		1884	2.90	275.1
1313	2.00		1894	3.00	276.4
1351	2.00		1903	3.20	278.3
1390	1.88		1935 (Extrap)	3.85	284.6
1428	1.50		2039	4.00 (?)	
1476	0.75				
1523	1.25				

# BIT RECORD

#	Type	Size (mm)	In	Out	Total (m)	Hrs drilled	FOB (daN)	RPM	Cond. T B G
1A	SM FD SS	311	0	281	281	25.00	6-8	180	6-4-I
2A	V L127XG	311	281	501	220	32.50	5-8	180	5-4-I
1B	R S21GT	445	0	295	295	19.75	6-10	140	3-5-I
2B	HC X33	445	295	503	208	32.50	6-12	140	4-4-I
1	ETD437XG	222	503	1118	615	61.00	6-14	65-120	4-4-I
2	ETD527XG	222	1118	1333	215	34.00	10-12	65-120	2-2-I
1C	ARC 325	156	1333	1351	18	2.00	3-4	60	GOOD
3RR2	ETD527XG	222	1351	1450	119	53.00	8-10	70-120	5-4-I
4	C3LRGSP	222	1520	1654	204	50.25	10-16	60-120	8-L2C
5	C45LRGS	222	1654	1654	0	Clean out to top of fish.			
6RR5	C45LRGSP	222	1654	1654	0	Clean out to top of fish.			
7	HC HR40C	222	1654	1696	42	14.50	8-12	100/135	6-E-1
8	SM GM89FD	222	1696	1783	87	40.40	8-12	100/135	4-E-I
9	SM GM89F	222	1783	1789	6	6.00	8-12	100	1-A-I
10RR9	SM GM89F	222	1789	1851	62	24.75	8-10	100/135	5-E-I
11	RD. HP64	222	1851	1917	66	32.00	8-10	100/145	6-E-I
12RR1	ETD437	222	1917	1917	0	Clean out trip.			
13	SM F57OD	222	1917	1935	18	11.5	8-10	90	2-E-I
14RR1	ETD437	222	1935	1935	0	Clean out trip.			
15RR13	ETD437	222	1933	2046	111	80.5	12-18	80	7-E-2

## BIT CONDITION

## SCALE

Tooth Wear	(T)	0 - 8
Bearing Wear	(B)	0 - 8
Gauge	(G)	in or (mm) under
New Bit	T=0	B=0 G=in



# DAILY DRILLING CHRONOLOGY

Date	Depth 24:00	Progress (24 hrs)	Drilling (hrs)	Rig activity 00:00 - 24:00
02/09/99	214m	191m	15.00	Nipple up diverter and mix mud. Rig to spud. Held diverter drill. Spud at 05:30 hrs. 02/09/99. Drill and survey 311mm pilot hole. Clean mud rings from flow line.
02/10/99	348m	134m	18.25	Drill and survey 311mm pilot hole. Trip out of hole for bit change at 281m. Make up and run BHA into hole. Clean out bridges from 205m to bottom. Drill and survey 311mm pilot hole.
02/11/99	492m	144m	22.25	Drill and survey 311mm pilot hole.
02/12/99	501m	9m	16.50	Drill and survey 311mm pilot hole to 501m. Trip out of hole. Lay down pipe and collars. Tight hole 377m - 256m. Make up BHA and open hole to 444.5mm. Drill 445mm hole. Survey.
02/13/99	501m	0m	19.00	Open hole to 444.5mm to 295m. Circulate bottoms up. Trip out of hole for bit change. Clean hole 280m to 295m. Open hole to 444.5mm to 363m.
02/14/99	503m	2m	20.00	Ream out 311mm hole to 444.5mm to 501m. Drill 444.5mm hole to 503m. Circulate hole clean. Perform wiper trip. Hole tight 247m to 185m.
02/15/99	503m	0m	0.00	RIH. clean 401m to bottom. Circulate and condition hole. Trip out of hole and lay down 200mm drill collars. Run joints of 349.7mm, 81.1kg/m, K-55, LT&C, 8rd, surface casing landed at 503m. Circulate and condition hole. Rig up cementers.

DAILY DRILLING CHRONOLOGY (cont.)

Date	Depth 24:00	Progress (24 hrs)	Drilling (hrs)	Rig activity 00:00 - 24:00
				Cement surface casing. Wait on cement.
02/16/99	503m	0m	0.00m	Wait on cement. Cut casing. Remove pipe racks and cat walk to break down diverter and related equipment. Install casing head, BOP stack, and HCR lines. Change out rams. Re-install catwalk and tie in manifold. Circulate invert at tank farm.
02/17/99	560m	57m	5.00	Nipple up BOPs. Pressure test with Falcon Pressure Testers. Make up BHA and RIH. Circulate. Pressure test lower pipe rams, upper pipe rams, annular, BOP valves, HCR valve, kill line valves, stabbing valve, inside BOP, upper and lower kelly cocks. Drill out float, cement, and shoe. Drill 5m 222mm hole. Circulate bottoms up. Perform leak off test. Drill 222mm hole. Survey.
02/18/99	800m	240m	20.25	Drill 222mm hole. Survey.
02/19/99	984m	184m	22.00	Drill 222mm hole. Survey.
02/20/99	1118m	134m	14.25	Drill 222mm hole. Survey. Circulate bottoms up. Trip out of hole. Work tight hole at 928m. Make up BHA and RIH. Clean to bottom.
02/21/99	1234m	116m	22.25	Drill 222mm hole. Survey.



DAILY DRILLING CHRONOLOGY (cont.)

Date	Depth 24:00	Progress (24 hrs)	Drilling (hrs)	Rig activity 00:00 - 24:00
02/22/99	1333	99m	12.00	Drill 222mm hole to 1306m. Circulate up sample. Drill 222mm hole to 1325m. Circulate up sample. Drill 222mm hole to 1331m. Circulate up sample. Drill 222mm hole to 1332m. Circulate up sample. Drill 222mm hole to 1333m. Circulate up sample. Pump pill and trip out of hole. Pick up core barrels. Slip and cut drilling line.
02/23/99	1363m	30m	8.00	Wait on jars. R.I.H. Clean 16m to bottom. Circulate. Drop ball. Cut Core #1. Circulate bottoms up. Pump pill. Trip out of hole and recover core. Service and lay down core barrels. Make up BHA and RIH. Ream rathole. Drill 222mm hole. Survey.
02/24/99	1454m	91m	16.00	Drill 222mm hole to 1452m. Circulate. Pump pill. Trip out of hole for bit change. Make up BHA and RIH. Clean 8m to bottom. Drill 222mm hole.
02/25/99	1587m	133m	21.00	Drill 222mm hole. Survey.
02/26/99	1638m	51m	22.00	Drill 222mm hole. Survey.

DAILY DRILLING CHRONOLOGY (cont.)

Date	Depth 24:00	Progress (24 hrs)	Drilling (hrs)	Rig activity 00:00 - 24:00
02/27/99	1654m	16m	6.50	Drill 222mm hole. Survey. Pump pill and trip out of hole. Missing 2 cones. Lay down 2 drill collars. RIH with near bit stabilizer. Problems with rubber from cement wiper plug. Trip out of hole and lay down stabilizer. Change out BHA and RIH. Ream undergauge hole.
02/28/99	1654m	0m	5.25	Ream undergauge hole from 1636m to 1654m. Trip out of hole. RIH with magnet Circulate to top of fish Work tool. Trip out of hole. Recover steel slivers. RIH with mill. Mill on fish. Trip mill out of hole. Trip mill out of hole. Make up magnet and RIH. Circulate and work magnet. Trip out of hole. Recover steel slivers and bearings. RIH with bit. Circulate and work on junk. Trip out of hole. RIH with magnet. Circulate and work magnet. Trip out of hole and recover 1 cone. RIH with magnet.
03/01/99	1654m	0m	0.00	
03/02/99	1687m	33m	9.25	RIH with magnet. Circulate and work magnet. Trip out of hole and recover 1 cone and 2 bearing carriers. Pick up United Geocom directional drilling tools and MWD. Directional survey to bottom. Drill 222mm hole. Slide 1678m to 1687m.

DAILY DRILLING CHRONOLOGY (cont.)

Date	Depth 24:00	Progress (24 hrs)	Drilling (hrs)	Rig activity 00:00 - 24:00
03/03/99	1714m	27m	15.50	Directional drill 22mm hole to 1696m. Trip out of hole. Change bit and set up motor to 1.25. RIH. Directional drill 222mm hole.
03/04/99	1763m	49m	22.00	Directional drill 222mm hole. Survey.
03/05/99	1789m	26m	12.75	Directional drill 222mm hole to 1783m. Survey. Trip out of hole for bit change. RIH with NB # 9. Directional drill 222mm hole to 1789m. Trip out of hole for mud motor failure.
03/06/99	1828m	39m	16.25	Trip out of hole and change out mud motor. RIH and clean to bottom. 1.5m fill. Directional drill 222mm hole. Survey.
03/07/99	1863m	35m	14.50	Directional drill 222mm hole. Survey. Circulate up sample. Trip out of hole for mud motor failure. Change bit and mud motor and RIH. Slip drilling line and finish RIH. Clean to bottom. 3m fill.
03/08/99	1908m	45m	22.50	Directional drill 222mm hole. Survey.
03/09/99	1917m	9m	3.50	Directional drill 222mm hole. Survey. Stop drilling at 1917m and circulate up sample. Pump pill. Trip out of hole and lay down directional tools. Make up test tools and RIH. Perform DST #1. Pull test tools free and pull out of hole. Recover fluid.



DAILY DRILLING CHRONOLOGY (cont.)

Date	Depth 24:00	Progress (24 hrs)	Drilling (hrs)	Rig activity 00:00 - 24:00
03/10/99	1926m	9m	6.00	Reverse circulate out DST #1 recovery. Trip out of hole and recover and read recorders. Service test tool and laydown on catwalk. RIH for clean out trip. Circulate and trip out of hole. Break down and load out test tools. RIH. Circulate to bottom. Drill 222mm hole.
03/11/99	1935m	9m	5.50	Drill 222m hole to a total depth of 1935m. Circulate up sample. Wiper trip. Circulate and condition hole. Trip out of hole. Rig up Baker Atlas and log well.
03/12/99	1935m	0m	0.00	Finish logging with Baker Atlas. Pick up Baker Oil Tools test tools. RIH and perform DST #2. Lost seat during preflow. Trip out of hole. Recover and read recorders. Change out top and bottom packers. Dump and save fluid from 1 BHS. Make up tools and RIH. Head up and prepare for DST #3.
03/13/99	1935m	0m	0.00	Perform DST #3. Trip out of hole with test tools. Reverse out 200m of fluid recovery. Finish tripping out of hole. Recover recorders, samplers, and service tool. Slip and cut drilling line. Trip in hole. Head up and perform DST #4.

DAILY DRILLING CHRONOLOGY (cont.)

Date	Depth 24:00	Progress (24 hrs)	Drilling (hrs)	Rig activity 00:00 - 24:00
03/14/99	1935m	0m	0.00	Perform DST #4. Trip out of hole with test tools. RIH with DST #5. Perform DST #5.
03/15/99	1935m	0m	0.00	Perform DST #5. Trip out of hole with test tools. Lay down tools and RIH for clean out. Circulate hole clean. Trip out of hole. Make up test tool and RIH. Perform DST #6.
03/16/99	1942m	7m	8.00	Perform DST #6. Trip out of hole with test tools. Service and load out test tools. Make up BHA and strap in hole. Clean to bottom and drill 222mm hole.
03/17/99	1982m	40m	23.25	Drill 222mm hole.
03/18/99	2016m	34m	19.25	Drill 222mm hole. Circulate up sample. W.O.O. Drill 222mm hole.
03/19/99	2046m	30m	18.50	Drill 222mm hole. Circulate up sample. Drill 222mm hole. Circulate up sample. Wiper trip. Circulate and condition hole.
03/20/99	2046m	0m	0.00	Circulate and condition hole. Strap out to log. Log with Baker Atlas. Rig out loggers. Lay down collars. Pick up Baker test tools and RIH. Perform DST #7.

DAILY DRILLING CHRONOLOGY (cont.)

Date	Depth 24:00	Progress (24 hrs)	Drilling (hrs)	Rig activity 00:00 - 24:00
03/21/99	2046m	0m	0.00	Perform DST #7. Deflate, pull free, and trip out of hole. Recover recorders and service tools. Make up DST #8 and RIH. Pump up packers. No seat. Try unsuccessfully to re-pump up packers. Trip out of hole. Change out bottom packer and pump.
03/22/99	2046m	0m	0.00	Make up test tool. RIH with DST #9. Perform DST #9. POOH, recover fluid, service test tool, and recover recorders. Break down test tool and load out. RIH with bit. Circulate and condition hole. Lay down pipe.



DRILLSTEM TEST

DRILLSTEM TEST No. 1

Date: March 9-10, 1999  
Formation: Mattson  
Interval: 1906m to 1917m  
Test type: Bottom Hole Conventional  
Packers: 177mm  
Hole size: 222mm  
Drill pipe: OD: 114.0mm ID: 63.5mm  
Collars: OD: 165.0mm ID: 71.0mm  
Testing Company: Baker Oil Tools/Delta P Test Corp.

PRESSURES:

Times:

IH:	18259 kPa	
1st IPF:	9440 kPa	1st PF: 10 min
1st FPF:	14369 kPa	
1st SI:	17356 kPa	1st SI: 3 min
2nd IPF:	17982 kPa	2nd PF: 15 min
2nd FPF:	17429 kPa	
2nd SI:	17516 kPa	2nd SI: 60 min
3rd IF:	17516 kPa	VO: 60 min
FF:	17541 kPa	
FSI:	17574 kPa	FSI: 120 min
FH:	18211 kPa	BHT: 64.3 C

NOTE: Above pressures are from real time charts. Unable to get pressures in field from downhole recorder due to tool plugging.

Results:

Flow comments: 1st PF: No blow for 7 minutes as air line to test head was not open. When air line opened had SAB immediately. NGTS. Delta P real time tool indicated test tool probably plugged.  
2nd PF: WAB increasing to SAB in 10 minutes. NGTS.  
VO: WAB throughout. NGTS. Delta P real time tool indicated test tool was still shut in. This suggested tool was plugged.

Recovery: 660m of fluid (Top 108m was invert and salty water. Bottom 552m was salty water.). Salinity 22000 ppm.

DRILLSTEM TEST

DRILLSTEM TEST No. 1

Test comments: Delta P real time chart indicated tool plugged 5 minutes into 1st preflow. Lack of draw down made it difficult to get reliable build up pressures. Baker Tools advised Paramount office there was enough information on charts to do Horner plot.

1 invert sample (sample 1-MT) collected at flow line prior to running test. 4 recovery samples. Sample 1-A: taken at top of recovery column at 660m was invert and salty water. Sample 1-B: taken at 552m was salty water. Sample 1-C: taken at 200m was salty water. Sample 1-D: taken at bottom of recovery at 0m was invert that was used to reverse circulate out recovery. Bottom hole sampler #246. All samples sent to AGAT Labs, Fort St. John, via Baker Oil Tools Tester, Bob Allen.

DRILLSTEM TEST

DRILLSTEM TEST No. 2

Date: March 12, 1999  
Formation: Mattson  
Interval: 1865m to 1892m  
Test type: Inflate Straddle  
Packers: 178mm  
Hole: 222mm  
Drill Pipe: OD: 114.0mm ID: 63.5mm  
Collars: OD: 165.0mm ID: 71.0mm  
Testing Company: Baker Oil Tools/Delta P Test Corp.

PRESSURES:

Times:

IH:	18228 kPa	
1st IPF:	241 kPa	1st PF: 11 min
1st FPF:	418 kPa	
FH:	18212 kPa	
ISI:(2 min)	4220 kPa*	BHT: 60.2 C

\*Delta P real time chart

Results:

Flow comments: 1st PF: WAB throughout. Lost packer seat 2 minutes into ISI.

Recovery: 15m of invert.

Test Comments: Packer seat held for PF. Mud started to leak around packers at ISI. Pumped packers up for an additional 20 minutes. Could not get seat. Moved packers up 1m and pumped up packers for 30 min. Unable to get seat. Discontinue test.  
1 invert sample (sample 2-MT) collected at flow line prior to running test. Sample 2-A: taken at top of 15m of recovery was invert. One bottom hole sample was dumped on location. 3 sample bottles collected from the bottom hole sampler (samples labelled DST #2 BHS) were invert.



### DRILLSTEM TEST

#### DRILLSTEM TEST No. 3

Date: March 12-13, 1999  
Formation: Mattson  
Interval: 1819m to 1848m  
Test type: Inflate Straddle  
Packers: 178mm  
Hole: 222mm  
Drill Pipe: OD: 114.0mm ID: 63.5mm  
Collars: OD: 166.0mm ID: 71.0mm  
Testing Company: Baker Oil Tools/Delta P Test Corp.

#### PRESSURES:

#### Times:

IH:	17798 kPa	
IPF:	534 kPa	PF: 10 min
FPP:	855 kPa	
ISI:	15044 kPa	ISI: 60 min
IF:	740 kPa	VO: 120 min
FF:	2128 kPa	
FSI:	16525 kPa	FSI: 240 min
FH:	17797 kPa	BHT: 61.9 C

#### Results:

Flow comments: PF: WAB increasing to SAB in 30 sec. GTS in 6.5 minutes.  
Lazy 3m flare through a 6.35mm (0.25") choke.  
VO: WAB increasing to SAB in 10 sec. GTS immediately. Lazy 1.5m  
flare. Changed choke to 3.175mm (0.125"). Lazy 1.5m flare. 60  
kPa pressure at the floor manifold indicated a flow of  
214m3/day (7557ft3/day).

Recovery: 200m of fluid (Top 100m was gassy invert. Bottom 100 metres was  
gassy water cut invert. Sample caught at very top of tool was  
salty water (34000ppm Cl)

## DRILLSTEM TEST

### DRILLSTEM TEST No. 3

Test comments: Delta P real time tool signal was lost just prior to PF. The signal was regained at the start of the FSI.  
1 invert sample (sample 3-MT) was collected from mud tank prior to running test. Gas bomb 11293 was collected during PF. Gas bomb 20129 was collected at the VO. 5 samples of the fluid recovery were taken. Sample 3-A: taken at the top of the recovery column at 200m was gassy invert. Sample 3-B: taken at at the 175m level of the fluid recovery was gassy invert. Sample 3-C: taken at 100m was gassy water cut invert. Sample 3-D: taken at 25m from the tool was gassy water cut invert. Sample 3-E: taken just at top of tool was water with a salinity of 34000ppm Cl. 2 sample bottles (labelled 3-BHS) containing contents of 1 emptied bottom hole sampler. 1 bottom hole sampler.

# DRILLSTEM TEST

DRILLSTEM TEST No. 4

Date: March 13-14, 1999  
Formation: Mattson  
Interval: 1781m to 1804.5m  
Test type: Inflate Straddle  
Packers: 178mm  
Hole: 222mm  
Drill Pipe: OD: 114.0mm ID: 63.5mm  
Collars: OD: 165.0mm ID: 71.0mm  
Testing Company: Baker Oil Tools

## PRESSURES:

IH: 17494 kPa  
IPF: 253 kPa  
FPF: 338 kPa  
ISI: 763 kPa  
IF: 239 kPa  
FF: 297 kPa  
FSI: 2391 kPa  
FH: 17449 kPa

## Times:

PF: 10 min  
ISI: 60 min  
VO: 180 min  
FSI: 360 min  
BHT: 61.7 C

## Results:

Flow comments: PF: WAB increasing to FAB in 10 minutes. NGTS.  
VO: Strong initial surge. Vented. WAB increasing to SAB after 150 min. NGTS.

Recovery: 10M of gassy invert.

Test comments: Test indicates a low permeability gas reservoir.  
Collected 1 invert drilling fluid sample (sample 4-MT) prior to running test. Collected 2 recovery samples (sample 4-A & sample 4-B) from top of tool.



DRILLSTEM TEST

DRILLSTEM TEST No. 5

Date: March 14, 1999  
Formation: Chinkeh  
Interval: 1405m to 1429m  
Test type: Inflate Straddle  
Packers: 178mm  
Hole size: 222mm  
Drill Pipe: OD: 114.0mm ID: 63.5mm  
Collars: OD: 165.0mm ID: 71.0mm  
Testing Company: Baker Oil Tools

PRESSURES:

IH: 13895 kPa  
IPF: 166 kPa  
FPF: 258 kPa  
ISI: 10900 kPa  
IF: 283 kPa  
FF: 652 kPa  
FSI: 10903 kPa  
FH: 13813 kPa

Times:

PF: 10 min  
ISI: 60 min  
VO: 120 min  
FSI: 240 min  
BHT: 49.6 C

Results:

Flow comments: PF: VWAB steady throughout. NGTS.  
VO: VWAB steady throughout.

Recovery: 45m of invert.

Test comments: Collected 1 mud tank sample (sample 5-MT) prior to running test. Collected 3 samples of fluid recovery. Sample 5-A was collected from top of 45m recovery column. Sample 5-B was from middle of fluid recovery column. Sample 5-C was collected from bottom of recovery column. 2 bottom hole samplers.

DRILLSTEM TEST

DRILLSTEM TEST No. 6

Date: March 15-16, 1999  
Formation: Fantasque  
Interval: 1668m to 1698m  
Test type: Inflate Straddle  
Packers: 178mm  
Hole: 222mm  
Drill Pipe: OD: 114.0mm ID: 63.5mm  
Collars: OD: 165.0mm ID: 71.0mm  
Testing Company: Baker Oil Tools

PRESSURES:

IH: 16389 kPa  
IPF: 610 kPa  
FPF: 1075 kPa  
ISI: 15104 kPa  
IF: 1239 kPa  
FF: 5134 kPa  
FSI: 15071 kPa  
FH: 16380 kPa

Times:

PF: 10 min  
ISI: 60 min  
VO: 120 min  
FSI: 240 min  
BHT: 60.6 C

Results:

Flow comments: PF: WAB increasing to SAB in 2.5 min. Increasing throughout.  
NGTS.  
VO: WAB increasing to SAB in 2 min. GTS in 30 min. Lazy 1m  
flare. TSTM.

Recovery: 490m of fluid recovery (90 m of gassy invert, 200m of gassy  
invert slightly contaminated with salt water, and 200m of gassy  
salt water.).

### DRILLSTEM TEST

#### DRILLSTEM TEST No. 6

Test comments: Collected 1 sample (sample 6-MT) of drilling fluid from mud tank prior to running test. Collected 1 gas bomb (ser.no. 18796) at 60 min. into VO. Collected 6 samples of reverse circulated recovery. Sample 6-A: collected from the top of the 490m of fluid recovery was gassy invert. Sample 6-B: collected from the 400m level of the fluid recovery was gassy contaminated invert. Sample 6-C: collected at 300m was gassy contaminated invert. Sample 6-D: collected at 200m level of recovery was gas cut salt water. Sample 6-E: collected at 100m was gas cut salt water. Sample 6-F was collected at the top of the tool and consisted of gassy salt water (50000ppm Cl). 2 bottom hole samplers.  
All samples shipped to AGAT Labs, Fort St. John, via Baker Oil Tools tester Ken Willis.



DRILLSTEM TEST

DRILLSTEM TEST No. 7

Date: March 20-21, 1999  
Formation: Mattson  
Interval: 2028m to 2046m  
Test type: Bottom Hole Inflate  
Packers: 177mm  
Hole: 222mm  
Drill Pipe: OD: 114.0mm ID: 63.5mm  
Collars: OD: 165.0mm ID: 71.0mm  
Testing Company: Baker Oil Tools

PRESSURES:

IH: 20228 kPa  
IPF: 452 kPa  
FPF: 611 kPa  
ISI: 2732 kPa  
IF: 376 kPa  
FF: 735 kPa  
FSI: 4693 kPa  
FH: 19863 kPa

Times:

PF: 10 min  
ISI: 60 min  
VO: 120 min  
FSI: 240 min  
BHT: 68.0 C

Results:

Flow comments: PF: WAB increasing to SAB in 30 sec. then decreasing to FAB to end of PF. NGTS.  
Note: Tool opened 5 times and skidded 2 metres before 10 min.  
PF. No mud was lost.  
VO: WAB increasing to SAB in 30 sec. for 4 min. then decreasing to FAB to end of VO. NGTS.

Recovery: 62.0m of gasified invert.

Test comments: Collected 1 sample (sample 7-MT) of drilling fluid from mud tank prior to running test. Collected 4 samples of fluid recovery. Sample 7-01: collected at 45m level of recovery column; Sample 7-02: collected at 27m level of recovery column; Sample 7-03: collected at 9m level of recovery column; Sample 7-04: collected at top of tool.

DRILLSTEM TEST

DRILLSTEM TEST No. 8

Date: March 21, 1999

Formation: Mattson

Interval: 1955m to 1965m

Test type: Inflate Straddle

Packers: 177mm

Hole: 222mm

Drill Pipe: OD: 114.0mm ID: 63.5mm

Collars: OD: 165.0mm ID: 71.0mm

Testing Company: Baker Oil Tools

PRESSURES:

IH: 19218 kPa

IPF:

FPF:

ISI:

IF:

FF:

FSI:

FH: 19199 kPa

Times:

PF:

ISI:

VO:

FSI:

BHT: 63.1 C.

Results:

Flow comments:

Recovery:

Test comments: DST #8 was declared a misrun as unable to inflate packer.  
Inspection when out of hole showed blown bottom packer.

DRILLSTEM TEST

DRILLSTEM TEST No. 9

Date: March 22, 1999  
Formation: Mattson  
Interval: 1955m to 1965m  
Test type: Inflate Straddle  
Packers: 177mm  
Hole: 222mm  
Drill Pipe: OD: 114.0mm ID: 63.5mm  
Collars: OD: 165.0mm ID: 71.0mm  
Testing Company: Baker Oil Tools

PRESSURES:

IH: 19218 kPa  
IPF: 581 kPa  
FPF: 2811 kPa  
ISI:  
IF:  
FF:  
FSI:  
FH: 19207 kPa

Times:

PF: 8 min  
ISI:  
VO:  
FSI:  
BHT:

Results:

Flow comments: PF: WAB. NGTS. Lost packer seat after 8 min.

Recovery: 265m of fluid recovery (100m of gasified invert; 50m of water cut gassy invert; 115m of salty water (18000ppm Cl)

Test comments: Test declared a misrun as packers blew 8 min. into PF. Collected 1 sample (sample 9-MT) of invert drilling fluid from mud tank prior to running test. Collected 6 samples of reverse circulated recovery. Sample 9-01: collected at the top of the recovery column at 265m was gasified invert; Sample 9-02: collected at 200m level was gasified invert; Sample 9-03: collected at 165m was water cut invert; Sample 9-04: collected at 155m was salty water; Sample 9-05: collected at 75m was salty water; Sample 9-06: collected at top of tool was salty water. 2 bottom hole samplers. All samples sent to AGAT Labs, Fort St John, via Baker Oil Tools tester Marc Sampietro.



# DETAILED CORE DESCRIPTION

Core No. 1	Interval: 1333.0m - 1351.2m	Cut: 18.2m
Depth (m)	Formation: Garbutt	Recovered: 18.2m
1333.0 - 1333.6	<b>SHALE</b> - dark gray, very silty and grading to very argillaceous siltstone, non calcareous, very carbonaceous;	
1333.6 - 1333.67	<b>SANDSTONE</b> - medium brown gray, very fine grained, subangular to angular, well sorted, no apparent fluorescence, slow bluish cut, trace mica, non calcareous, thinly laminated, moderately argillaceous, very silty, trace glauconite;	
1333.67 - 1333.72	<b>SHALE</b> - as above, very silty, very carbonaceous;	
1333.72 - 1334.47	<b>SANDSTONE</b> - light medium gray salt and pepper, very fine grained, subangular to angular, well sorted, no apparent fluorescence, slow bluish cut, trace mica, non to moderately calcareous, <u>rare pinpoint porosity</u> to no visible porosity, very silty, scattered glauconite;	
1334.47 - 1335.27	<b>SHALE</b> - dark gray, very silty in part, occasional (2) sandstone interbeds (4cm), no shows, tight, very silty, very carbonaceous;	
1335.27 - 1335.87	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, as above, slightly argillaceous in part, tight, very silty;	
1335.87 - 1336.77	<b>SHALE</b> - as above, interbedded with very fine grained very carbonaceous slightly calcareous sandstone laminae, very silty, very carbonaceous;	
1336.77 - 1337.07	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, as above, slightly argillaceous in part, tight, very silty;	
1337.07 - 1339.4	<b>SHALE</b> - dark gray, as above, grading to argillaceous siltstone, very silty, very carbonaceous;	
1339.4 - 1339.5	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, as above, slightly argillaceous in part, tight, very silty	
1339.5 - 1351.2	<b>SHALE</b> - very dark gray, poker chip partings, very rare sandstone laminae, occasionally silty, rare slickensides, rare fossils (Ammonite?, fish skeletal fragments), very carbonaceous;	



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
0 - 20	<b>CLAYSTONE</b> - medium gray, occasional very fine to coarse quartz grains, very soft, abundant aragonite, moderately silty;
20 - 25	<b>SANDSTONE</b> - medium gray to medium dark gray, very fine grained, subangular to angular, well sorted, abundant aragonite, trace Pelecypod, no shows, no visible porosity, moderately silty, moderately calcareous;
25 - 30	<b>SILTSTONE</b> - medium dark gray, non calcareous, abundant aragonite, tight, very argillaceous;
30 - 35	<b>SANDSTONE</b> - medium gray to medium dark gray, very fine grained, subangular to angular, well sorted, abundant aragonite, trace Pelecypod, no shows, no visible porosity, moderately silty, moderately calcareous;
35 - 40	<b>CLAYSTONE</b> - as above, abundant aragonite, very fine to finely arenaceous in part, very silty;
40 - 45	<b>SILTSTONE</b> - as above, very fine grained in part, very argillaceous;
45 - 65	<b>CLAYSTONE</b> - medium dark gray, scattered aragonite, soft, very silty;
65 - 90	<b>CLAYSTONE</b> - soft to moderately consolidated, as above, very silty, rare pyrite;
90 - 95	<b>SANDSTONE</b> - greenish gray, fine grained to medium grained, subangular to subrounded, well sorted, rare coarse grains, clay supported in part and grading to sandy claystone in part, no shows, tight, very argillaceous, slightly calcareous;
95 - 100	<b>CLAYSTONE</b> - as above, very fine to medium grained in part, trace rounded varicolored chert granules and pebbles, very silty;
100 - 105	<b>SANDSTONE</b> - medium gray salt and pepper, very fine grained, subangular to angular, well sorted, rare silt size pyrite, moderately calcareous in part, rare rounded chert pebbles, no shows, no visible porosity, very silty, very argillaceous;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
105 - 109	CLAYSTONE - medium dark gray, as above, rare trace rounded chert pebbles, grading to medium gray shale;
109 - 149	CLAYSTONE - medium gray to medium dark gray, non calcareous, soft, very silty;
149 - 166	CLAYSTONE - medium gray to medium dark gray, non calcareous, soft, very silty, increasingly indurated and shaley;
166 - 169	CONGLOMERATE - varicolored, very coarse grained, rounded, poorly sorted, <u>trace intergranular porosity</u> , clay matrix in part, medium grained sand matrix in part, siliceous cemented, slightly pyritic, kaolin infilling in part;
169 - 179	SANDSTONE - medium gray, very fine grained, subangular to angular, well sorted, occasionally fine grained, siltstone laminae, non calcareous, rare conglomeritic streaks, very silty, very argillaceous;
179 - 183	SILTSTONE - medium dark gray, non calcareous, grading to silty shale, trace medium brown gray slightly waxy shale laminae, very argillaceous;
183 - 186	SANDSTONE - medium light gray salt and pepper, fine grained to medium grained and some coarse grained, angular to subrounded, moderately sorted, no fluorescence, no cut, quartz, chert, rock fragments, trace varicolored rounded chert granules and pebbles, kaolin infilling in part, <u>intergranular porosity</u> , slightly argillaceous;
186 - 212	CONGLOMERATE - light medium gray, occasionally dark gray, poorly sorted, no fluorescence, no cut, varicolored rounded chert granules and pebbles in a medium to coarse grained sand matrix, slightly siliceous cemented, <u>intergranular porosity in part</u> , slightly pyritic;
212 - 214	SANDSTONE - medium gray, fine grained to coarse grained, subangular to angular, moderately sorted, no shows, tight, very argillaceous, moderately silty;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
214 - 219	CONGLOMERATE - light medium gray, occasionally dark gray, poorly sorted, no fluorescence, no cut, varicolored rounded chert granules and pebbles in a medium to coarse grained sand matrix, slightly siliceous cemented, <u>intergranular porosity in part</u> , slightly pyritic;
219 - 220	SILTSTONE - medium gray, as above, non calcareous, very argillaceous;
220 - 224	SANDSTONE - medium gray, fine grained to medium grained, subangular to angular, well sorted, grading to very argillaceous siltstone, no shows, no visible porosity, very silty, very argillaceous;
224 - 227	SHALE - medium light gray, medium gray to medium dark gray, soft, non calcareous, silty in part, scattered carbonaceous material;
227 - 228	SILTSTONE - medium gray, as above, very argillaceous;
228 - 229	SANDSTONE - light medium gray, very fine grained to fine grained, subangular to angular, well sorted, non calcareous, micaceous, moderately silty, very argillaceous;
229 - 230	SILTSTONE - medium gray, as above, very argillaceous;
230 - 232	SANDSTONE - light medium gray, very fine grained to fine grained, subangular to angular, well sorted, non calcareous, micaceous, moderately silty, very argillaceous;
232 - 236	SILTSTONE - medium gray, as above, very argillaceous;
236 - 240	SANDSTONE - light medium gray, very fine grained to fine grained, subangular to angular, well sorted, non calcareous, micaceous, moderately silty, very argillaceous;
240 - 243	SHALE - light greenish gray, light medium gray, micromicaceous, non calcareous, moderately bentonitic;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
243 - 246	SANDSTONE - medium light gray salt and pepper, fine grained to medium grained, subangular to angular, well sorted, moderately consolidated, micaceous, kaolin infilling in part, no shows, very fine to fine grained and silty in part, <u>scattered intergranular porosity</u> , slightly argillaceous;
246 - 247	SILTSTONE - medium gray, as above, very argillaceous;
247 - 252	SANDSTONE - medium light gray salt and pepper, fine grained to medium grained, subangular to angular, well sorted, moderately consolidated, micaceous, kaolin infilling in part, no shows, very fine to fine grained and silty in part, <u>scattered intergranular porosity</u> , slightly argillaceous;
252 - 253	SILTSTONE - medium gray, as above, very argillaceous;
253 - 259	SANDSTONE - medium light gray salt and pepper, medium grained to coarse grained, subangular to angular, well sorted, no fluorescence, no cut, conglomeritic in part, slightly siliceous cemented, kaolin infilling in part, <u>intergranular porosity</u> ;
259 - 267	CONGLOMERATE - light medium gray, poorly sorted, no fluorescence, no cut, rounded varicolored chert pebbles in matrix of medium to coarse grained sand, <u>intergranular porosity</u> ;
267 - 272	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, micaceous, non calcareous, very silty and grading to siltstone, very argillaceous;
272 - 275	SANDSTONE - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, no visible porosity, very silty, very argillaceous;
275 - 280	SILTSTONE - medium light gray to medium dark gray, no shows, tight, very argillaceous;
280 - 286	SILTSTONE - medium dark gray, as above, very shaley, very argillaceous;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
286 - 291	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, no shows, tight, very silty, very argillaceous;
291 - 292	SANDSTONE - medium light gray, very fine grained to fine grained, subangular to angular, well sorted, kaolin infilling in part, very silty, very argillaceous;
292 - 294	SILTSTONE - medium dark gray, as above, very shaley, very argillaceous;
294 - 298	SHALE - medium brown gray, carbonaceous material, moderately bentonitic, moderately silty;
298 - 299	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, micaceous, no shows, tight, very silty, very argillaceous;
299 - 300	SILTSTONE - medium dark gray, as above, very shaley, very argillaceous;
300 - 301	SHALE - medium brown gray, carbonaceous material, moderately bentonitic, moderately silty;
301 - 302	SILTSTONE - medium dark gray, as above, very shaley, very argillaceous;
302 - 304	SANDSTONE - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, kaolin infilling in part, micaceous, no shows, no visible porosity, very silty, very argillaceous;
304 - 310	SILTSTONE - medium light gray salt and pepper to medium light gray, very finely arenaceous, tight, very argillaceous;
310 - 315	SANDSTONE - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, micaceous, kaolin infilling in part, non to slightly calcareous, no shows, tight, very silty, very argillaceous;
315 - 322	SILTSTONE - medium dark gray, as above, very argillaceous, very shaley;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
322 - 323	SHALE - as above;
323 - 324	SANDSTONE - very fine grained to fine grained, subangular to angular, well sorted, no shows, tight, very silty, very argillaceous;
324 - 326	SHALE - as above;
326 - 330	SANDSTONE - light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, no fluorescence, no cut, abundant kaolin infilling in part, very calcareous cemented, trace dark gray carbonaceous shale laminae, <u>trace intergranular porosity</u> ;
330 - 333	COAL - black, vitreous;
333 - 334	SHALE - dark gray, as above, non calcareous, moderately carbonaceous;
334 - 335	SILTSTONE - medium dark gray, as above, very argillaceous;
335 - 337	SANDSTONE - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, w sorted, abundant kaolin in part, no shows, no visible porosity, very argillaceous, moderately silty;
337 - 340	SILTSTONE - medium dark gray, as above, very argillaceous;
340 - 344	SANDSTONE - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, as above, trace carbonaceous laminae, very argillaceous, moderately silty;
344 - 346	SHALE - dark gray, as above, non calcareous, moderately carbonaceous;
346 - 349	SILTSTONE - as above, scattered carbonaceous material, light gray bentonitic shale and dark gray shaley carbonaceous laminae, very argillaceous;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
349 - 351	<b>SANDSTONE</b> - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, no fluorescence, no cut, moderately calcareous cemented in part, kaolin infilling in part, micaceous, occasional carbonaceous siltstone laminae, <u>trace intergranular porosity</u> ;
351 - 352	<b>SILTSTONE</b> - as above, scattered carbonaceous material, light gray bentonitic shale and dark gray shaley carbonaceous laminae, very argillaceous;
352 - 362	<b>SANDSTONE</b> - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, no fluorescence, no cut, moderately calcareous cemented in part, kaolin infilling in part, as above, <u>rare trace intergranular porosity</u> ;
362 - 363	<b>SILTSTONE</b> - as above, scattered carbonaceous material, light gray bentonitic shale and dark gray shaley carbonaceous laminae, very argillaceous;
363 - 364	<b>SHALE</b> - dark gray, non calcareous, moderately carbonaceous;
364 - 367	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, scattered carbonaceous material, no shows, tight, very silty;
367 - 375	<b>SILTSTONE</b> - medium dark gray, scattered carbonaceous material, micromicaceous, non calcareous, very argillaceous;
375 - 377	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, as above, very argillaceous, very silty;
377 - 382	<b>SILTSTONE</b> - medium dark gray, dark gray in part, micromicaceous, dark gray and carbonaceous in part, very finely arenaceous in part, non calcareous, no shows, tight, very argillaceous;
382 - 383	<b>SHALE</b> - as above, non calcareous;



LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
383 - 386	<b>SILTSTONE</b> - medium dark gray, dark gray in part, micromicaceous, dark gray and carbonaceous in part, very finely arenaceous in part, non calcareous, no shows, tight, very argillaceous;
386 - 387	<b>SHALE</b> - as above;
387 - 399	<b>SILTSTONE</b> - as above, very argillaceous, slightly carbonaceous;
399 - 406	<b>SILTSTONE</b> - as above, very finely arenaceous in part, very argillaceous, slightly carbonaceous;
406 - 407	<b>SANDSTONE</b> - medium light gray salt and pepper, very fine grained, subangular to angular, well sorted, non calcareous, no shows, tight, very argillaceous, very silty;
407 - 411	<b>SILTSTONE</b> - as above, very finely arenaceous in part, very argillaceous, slightly carbonaceous;
411 - 416	<b>SHALE</b> - dark gray, blocky, micromicaceous in part, non calcareous, moderately silty;
416 - 418	<b>SHALE</b> - dark gray, blocky, non calcareous, micromicaceous in part;
418 - 423	<b>SANDSTONE</b> - medium light gray, very fine grained to fine grained, subangular to angular, well sorted, kaolin infilling, slightly calcareous in part, interbedded with siltstone as above, no observable porosity;
423 - 425	<b>SILTSTONE</b> - medium dark gray, as above, very argillaceous;
425 - 426	<b>SANDSTONE</b> - medium light gray, light medium gray, very fine grained to fine grained, subangular to angular, moderately sorted, no fluorescence, no cut, trace medium to coarse grained, trace chert pebbles, slightly to moderately calcareous cemented, slightly siliceous cemented, <u>intergranular porosity</u> ;
426 - 428	<b>SHALE</b> - as above;
428 - 435	<b>SILTSTONE</b> - as above, very finely arenaceous in part;



LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
435 - 439	SANDSTONE - very fine grained, subangular to angular, well sorted, as above, no shows, very silty;
439 - 445	SILTSTONE - as above, very finely arenaceous in part;
445 - 448	SANDSTONE - very fine grained, subangular to angular, well sorted, as above, very silty;
448 - 449	SILTSTONE - as above, very finely arenaceous in part;
449 - 450	SANDSTONE - very fine grained, subangular to angular, well sorted, as above, very silty;
450 - 453	SILTSTONE - as above, very finely arenaceous in part;
453 - 454	SANDSTONE - very fine grained, subangular to angular, well sorted, as above, very silty;
454 - 456	SILTSTONE - as above, very finely arenaceous in part;
456 - 463	SANDSTONE - medium light gray, very fine grained to fine grained, subangular to angular, well sorted, no fluorescence, no cut, kaolin infilling in part, slightly siliceous cemented, moderately to very argillaceous, micaceous in part, trace carbonaceous laminae, trace chert pebbles in sample, occasional streaks of slightly siliceous cemented fine grained sandstone with <u>intergranular porosity</u> , moderately silty;
463 - 473	SILTSTONE - as above, very argillaceous;
473 - 475	SANDSTONE - medium light gray to light medium gray, very fine grained to fine grained, subangular to angular, well sorted, occasional carbonaceous laminae, very silty in part, no visible porosity, very argillaceous;
475 - 477	SILTSTONE - as above, very argillaceous;
477 - 480	SANDSTONE - medium light gray to light medium gray, very fine grained to fine grained, subangular to angular, well sorted, occasional carbonaceous laminae, very silty in part, no visible porosity, very argillaceous;
480 - 482	SILTSTONE - as above, very argillaceous;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
482 - 483	<b>SANDSTONE</b> - medium light gray to light medium gray, very fine grained to fine grained, subangular to angular, well sorted, occasional carbonaceous laminae, very silty in part, no visible porosity, very argillaceous;
483 - 492	<b>SILTSTONE</b> - medium dark gray, as above, with interbeds of light medium gray very fine grained very silty very argillaceous sand, very argillaceous;
492 - 494	<b>SANDSTONE</b> - medium light gray to light medium gray, very fine grained to fine grained, subangular to angular, well sorted, very to moderately argillaceous, kaolin infilling in part, as above, very silty;
494 - 501	<b>SILTSTONE</b> - medium dark gray, as above, with interbeds and laminae of very fine to fine grained very to moderately argillaceous very silty sand, very argillaceous;
501 - 503	<b>SILTSTONE</b> - medium dark gray, as above, trace carbonaceous material, with laminae of very fine grained moderately argillaceous very silty sandstone, very argillaceous;
503 - 504	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, non calcareous, very argillaceous, very silty;
504 - 508	<b>SILTSTONE</b> - medium dark gray, as above, trace carbonaceous material, with laminae of very fine grained moderately argillaceous very silty sandstone, very argillaceous;
508 - 509	<b>SHALE</b> - medium dark gray, as above, very silty;
509 - 510	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, non calcareous, very argillaceous, very silty;
510 - 519	<b>SILTSTONE</b> - medium dark gray, as above, trace carbonaceous material, with laminae of very fine grained moderately argillaceous very silty sandstone, very argillaceous;
519 - 527	<b>SANDSTONE</b> - medium light gray, very fine grained, subangular to angular, well sorted, moderately dolomitic cemented, moderately silty;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
527 - 531	SILTSTONE - medium dark gray, as above, trace carbonaceous material, with laminae of very fine grained moderately argillaceous very silty sandstone, very argillaceous;
531 - 536	SANDSTONE - medium light gray, very fine grained, subangular to angular, well sorted, non calcareous, tight, moderately argillaceous, moderately silty;
536 - 541	SILTSTONE - medium dark gray, as above, trace carbonaceous material, with laminae of very fine grained moderately argillaceous very silty sandstone, very argillaceous;
541 - 542	SHALE - medium dark gray, non calcareous, very silty;
542 - 544	SILTSTONE - medium dark gray, as above, very argillaceous;
544 - 553	SANDSTONE - medium light gray, very fine grained, subangular to angular, well sorted, as above, slightly calcareous in part, rare glauconite, trace carbonaceous material, with siltstone interbeds, tight, very argillaceous, very silty;
553 - 560	SILTSTONE - medium dark gray, grading to silty shale in part, with non to slightly calcareous very fine grained sandstone laminae, very argillaceous;
560 - 564	SANDSTONE - medium light gray, very fine grained, subangular to angular, well sorted, as above, slightly calcareous in part, rare glauconite, trace carbonaceous material, with siltstone interbeds, tight, very argillaceous, very silty;
564 - 570	SHALE - dark gray, blocky, abundant silty laminae, soft, non calcareous, very silty;
570 - 573	SANDSTONE - medium light gray, very fine grained, subangular to angular, well sorted, as above, slightly calcareous in part, rare glauconite, trace carbonaceous material, with siltstone interbeds, tight, very argillaceous, very silty;
573 - 580	SILTSTONE - dark gray, grading to silty shale, with sandstone laminae, tight, very argillaceous;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
580 - 583	SANDSTONE - medium light gray, very fine grained, subangular to angular, well sorted, as above, slightly calcareous in part, rare glauconite, trace carbonaceous material, with siltstone interbeds, tight, very argillaceous, very silty;
583 - 586	SILTSTONE - dark gray, grading to silty shale, with sandstone laminae, tight, very argillaceous;
586 - 591	SHALE - dark gray, non calcareous, very silty;
591 - 592	SANDSTONE - medium light gray, very fine grained, subangular to angular, well sorted, non to slightly calcareous, tight, very argillaceous, very silty;
592 - 594	SHALE - dark gray, non calcareous, very silty;
594 - 599	SILTSTONE - grading to silty shale, with thin very fine grained sandstone interbeds, very argillaceous;
599 - 613	SILTSTONE - medium dark gray, grading to silty shale, very fine grained in part, very argillaceous;
613 - 618	SHALE - dark gray, trace fish scales, grading to shaley siltstone, non calcareous, very silty;
618 - 620	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, non to very slightly calcareous, tight, very argillaceous, very silty;
620 - 624	SILTSTONE - medium dark gray, grading to silty shale, very fine grained in part, very argillaceous;
624 - 628	SHALE - dark gray, trace fish scales, grading to shaley siltstone, non calcareous, very silty;
628 - 637	SILTSTONE - medium dark gray, grading to silty shale, very fine grained in part, very argillaceous;
637 - 643	SHALE - dark gray, trace fish scales, grading to shaley siltstone, non calcareous, very silty;
643 - 646	SILTSTONE - medium dark gray to dark gray, very shaley, non calcareous, very argillaceous, moderately carbonaceous;



LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
646 - 647	SHALE - as above;
647 - 659	SILTSTONE - medium dark gray to dark gray, very shaley, non calcareous, very argillaceous, moderately carbonaceous;
659 - 662	SHALE - dark gray, non calcareous, moderately carbonaceous;
662 - 665	SILTSTONE - dark gray, trace fish scales, shaley, as above, non calcareous, very argillaceous, moderately carbonaceous;
665 - 682	SILTSTONE - dark gray, non calcareous, very argillaceous, moderately carbonaceous;
682 - 683	SILTSTONE - as above, and medium brown slightly dolomitic siltstone;
683 - 685	SHALE - as above;
685 - 688	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty;
688 - 693	SHALE - dark gray, non calcareous, very silty, moderately carbonaceous;
693 - 702	SILTSTONE - light medium gray to medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
702 - 713	SILTSTONE - as above, shaley in part, very argillaceous, moderately carbonaceous;
713 - 719	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, slightly calcareous in part, grading to siltstone, tight, very argillaceous, very silty, moderately carbonaceous;
719 - 722	SILTSTONE - light medium gray, as above, very argillaceous, moderately carbonaceous;
722 - 724	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, slightly calcareous in part, grading to siltstone, tight, very argillaceous, very silty, moderately carbonaceous;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
724 - 725	SILTSTONE - light medium gray, as above, very argillaceous, moderately carbonaceous;
725 - 727	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, slightly calcareous in part, grading to siltstone, tight, very argillaceous, very silty, moderately carbonaceous;
727 - 729	SILTSTONE - light medium gray, as above, very argillaceous, moderately carbonaceous;
729 - 731	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, slightly calcareous in part, grading to siltstone, tight, very argillaceous, very silty, moderately carbonaceous;
731 - 733	SILTSTONE - light medium gray, as above, very argillaceous, moderately carbonaceous;
733 - 735	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, slightly calcareous in part, grading to siltstone, tight, very argillaceous, very silty, moderately carbonaceous;
735 - 736	SILTSTONE - light medium gray, as above, very argillaceous, moderately carbonaceous;
736 - 743	SILTSTONE - light medium gray, grading to very fine grained very silty very argillaceous sandstone, very argillaceous;
743 - 745	SHALE - dark gray, non calcareous, moderately silty, moderately carbonaceous;
745 - 747	SILTSTONE - light medium gray, grading to very fine grained silty sandstone, moderately argillaceous, moderately calcareous;
747 - 748	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, moderately calcareous;
748 - 750	SILTSTONE - light medium gray, grading to very fine grained silty sandstone, moderately argillaceous, moderately calcareous;



LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
750 - 752	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, moderately calcareous;
752 - 753	SHALE - dark gray, non calcareous, moderately silty, moderately carbonaceous;
753 - 756	SILTSTONE - light medium gray, grading to very fine grained silty sandstone, moderately argillaceous, moderately calcareous;
756 - 757	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, very argillaceous, very silty, moderately calcareous, trace glauconite;
757 - 759	SILTSTONE - light medium gray, grading to very fine grained silty sandstone, moderately argillaceous, moderately calcareous;
759 - 760	SHALE - dark gray, non calcareous, moderately silty, moderately carbonaceous;
760 - 762	SILTSTONE - light medium gray, grading to very fine grained silty sandstone, moderately argillaceous, moderately calcareous;
762 - 764	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, very argillaceous, very silty, moderately calcareous, trace glauconite;
764 - 765	SHALE - dark gray, non calcareous, moderately silty, moderately carbonaceous;
765 - 768	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, very argillaceous, very silty, moderately calcareous, trace glauconite;
768 - 770	SILTSTONE - light medium gray, grading to very fine grained silty sand, moderately argillaceous, very sandy, moderately calcareous;
770 - 772	SHALE - dark gray, non calcareous, moderately silty, moderately carbonaceous;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
772 - 780	SILTSTONE - light medium gray, grading to very fine grained silty sandstone, moderately argillaceous, moderately calcareous;
780 - 781	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, moderately calcareous;
781 - 782	SHALE - dark gray, grading to very argillaceous silt, very silty, moderately carbonaceous;
782 - 785	SILTSTONE - light to medium dark gray, carbonaceous laminae, grading to very silty shale, very argillaceous, moderately carbonaceous;
785 - 786	SHALE - dark gray, grading to very argillaceous silt, very silty, moderately carbonaceous;
786 - 787	SILTSTONE - light to medium dark gray, carbonaceous laminae, grading to very silty shale, very argillaceous, moderately carbonaceous;
787 - 793	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, moderately calcareous;
793 - 795	SHALE - dark gray, grading to very argillaceous silt, very silty, moderately carbonaceous;
795 - 800	SILTSTONE - light to medium dark gray, carbonaceous laminae, grading to very silty shale, very argillaceous, moderately carbonaceous;
800 - 803	SHALE - dark gray, grading to very argillaceous silt, very silty, moderately carbonaceous;
803 - 806	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, slightly calcareous;
806 - 808	SHALE - dark gray, grading to very argillaceous silt, very silty, moderately carbonaceous;



# LITHOLOGY

Formation tops  
Sample interval  
(in meters)

## SAMPLE DESCRIPTION

808 - 814	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
814 - 816	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, slightly calcareous;
816 - 818	<b>SHALE</b> - dark gray, soft, non calcareous, very silty, moderately carbonaceous;
818 - 819	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
819 - 820	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, slightly calcareous;
820 - 822	<b>SHALE</b> - dark gray, soft, non calcareous, very silty, moderately carbonaceous;
822 - 828	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
828 - 832	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, slightly calcareous;
832 - 837	<b>SHALE</b> - dark gray, soft, non calcareous, very silty, moderately carbonaceous;
837 - 841	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, slightly calcareous;
841 - 845	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
845 - 846	<b>SHALE</b> - dark gray, soft, non calcareous, very silty, moderately carbonaceous;



# LITHOLOGY

Formation tops  
Sample interval  
(in meters)

## SAMPLE DESCRIPTION

846 - 849	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
849 - 850	<b>SHALE</b> - dark gray, soft, non calcareous, very silty, moderately carbonaceous;
850 - 857	<b>SILTSTONE</b> - medium dark gray, trace very fine grained moderately calcareous glauconitic sandstone laminae, very argillaceous, moderately carbonaceous;
857 - 861	<b>SILTSTONE</b> - as above, increasingly shaley, very argillaceous, moderately carbonaceous;
861 - 864	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
864 - 865	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, slightly calcareous;
865 - 866	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
866 - 867	<b>SHALE</b> - dark gray, soft, non calcareous, very silty, moderately carbonaceous;
867 - 868	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
868 - 869	<b>SHALE</b> - dark gray, soft, non calcareous, very silty, moderately carbonaceous;
869 - 871	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
871 - 875	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, slightly calcareous;



LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
875 - 878	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
878 - 879	<b>SHALE</b> - dark gray, soft, non calcareous, very silty, moderately carbonaceous;
879 - 883	<b>SILTSTONE</b> - medium dark gray, as above, trace very fine grained sandstone laminae with <u>dull yellow fluorescence and slow bluish cut</u> , tight, very argillaceous;
883 - 891	<b>SILTSTONE</b> - medium dark gray, non to slightly calcareous, very finely arenaceous, very argillaceous, moderately carbonaceous, slightly calcareous;
891 - 892	<b>SHALE</b> - dark gray, soft, non calcareous, very silty, moderately carbonaceous;
892 - 895	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, tight, very argillaceous, very silty, trace glauconite;
895 - 901	<b>SILTSTONE</b> - medium dark gray, very calcareous streaks, trace very fine grained sandstone laminae, very shaley, very argillaceous, moderately carbonaceous;
901 - 903	<b>SANDSTONE</b> - medium dark gray, very fine grained, subangular to angular, well sorted, grading to very finely arenaceous siltstone in part, very argillaceous, very silty, moderately carbonaceous;
903 - 904	<b>SILTSTONE</b> - medium dark gray to dark gray, as above, very argillaceous, moderately carbonaceous;
904 - 908	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, as above, tight, very argillaceous, very silty, moderately carbonaceous;
908 - 923	<b>SILTSTONE</b> - medium dark gray to dark gray, as above, very argillaceous, moderately carbonaceous;
923 - 924	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, as above, tight, very argillaceous, very silty, moderately carbonaceous;

# LITHOLOGY

Formation tops  
Sample interval  
(in meters)

## SAMPLE DESCRIPTION

924 - 926	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;
926 - 929	<b>SILTSTONE</b> - medium dark gray to dark gray, as above, very argillaceous, moderately carbonaceous;
929 - 933	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;
933 - 934	<b>SILTSTONE</b> - medium dark gray to dark gray, as above, very argillaceous, moderately carbonaceous;
934 - 935	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, as above, tight, very argillaceous, very silty, moderately carbonaceous;
935 - 937	<b>SILTSTONE</b> - medium dark gray to dark gray, as above, very argillaceous, moderately carbonaceous;
937 - 938	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;
938 - 940	<b>SILTSTONE</b> - medium dark gray to dark gray, as above, very argillaceous, moderately carbonaceous;
940 - 945	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, as above, tight, very argillaceous, very silty, moderately carbonaceous;
945 - 946	<b>SILTSTONE</b> - medium dark gray to dark gray, as above, very argillaceous, moderately carbonaceous;
946 - 947	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;
947 - 949	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, as above, tight, very argillaceous, very silty, moderately carbonaceous;
949 - 951	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
951 - 957	<b>SILTSTONE</b> - medium dark gray, as above, rare very fine grained very silty laminae, very argillaceous, moderately carbonaceous;
957 - 958	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;
958 - 965	<b>SILTSTONE</b> - medium dark gray, as above, rare very fine grained very silty laminae, very argillaceous, moderately carbonaceous;
965 - 966	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;
966 - 970	<b>SILTSTONE</b> - medium dark gray, as above, rare very fine grained very silty laminae, very argillaceous, moderately carbonaceous;
970 - 971	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;
971 - 974	<b>SILTSTONE</b> - medium dark gray, as above, rare very fine grained very silty laminae, very argillaceous, moderately carbonaceous;
974 - 975	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;
975 - 981	<b>SILTSTONE</b> - medium dark gray, non calcareous, very shaley in part, very argillaceous, moderately carbonaceous;
981 - 988	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, trace mica, very calcareous cemented, no shows, no visible porosity, moderately argillaceous, very silty, trace glauconite;
988 - 994	<b>SANDSTONE</b> - as above, very fine grained, subangular to angular, well sorted, trace glauconite, very silty and grading to very finely arenaceous siltstone, tight, moderately argillaceous, slightly calcareous;
994 - 998	<b>SILTSTONE</b> - medium dark gray, as above, rare very fine grained very silty laminae, very argillaceous, moderately carbonaceous;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
998 - 1005	<b>SANDSTONE</b> - as above, very fine grained, subangular to angular, well sorted, trace glauconite, very silty and grading to very finely arenaceous siltstone, tight, moderately argillaceous, slightly calcareous;
1005 - 1014	<b>SILTSTONE</b> - as above, very finely arenaceous in part and very fine grained sandstone laminae and interbeds, very argillaceous, moderately carbonaceous;
1014 - 1015	<b>SANDSTONE</b> - as above, subangular to angular, well sorted, non calcareous, tight, very argillaceous, very silty;
1015 - 1018	<b>SILTSTONE</b> - medium dark gray, occasional very fine grained sandstone laminae, very argillaceous, moderately carbonaceous;
1018 - 1020	<b>SANDSTONE</b> - light medium gray, very fine grained, subangular to angular, well sorted, as above, no shows, tight, very argillaceous, very silty;
1020 - 1021	<b>SHALE</b> - dark gray, blocky, moderately silty in part, non calcareous, moderately carbonaceous;
1021 - 1024	<b>SILTSTONE</b> - medium dark gray, occasional very fine grained sandstone laminae, very argillaceous, moderately carbonaceous;
1024 - 1025	<b>SHALE</b> - dark gray, blocky, moderately silty in part, non calcareous, moderately carbonaceous;
1025 - 1038	<b>SILTSTONE</b> - medium dark gray, occasional very fine grained very silty moderately calcareous sandstone laminae, very argillaceous, moderately carbonaceous;
1038 - 1040	<b>SILTSTONE</b> - as above, interbed with dark gray moderately carbonaceous non calcareous shale, very argillaceous, moderately carbonaceous;
1040 - 1041	<b>SHALE</b> - dark gray, blocky, moderately silty in part, non calcareous, moderately silty, moderately carbonaceous;
1041 - 1042	<b>SILTSTONE</b> - as above, very argillaceous, moderately argillaceous, moderately sandy;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1042 - 1043	SHALE - dark gray, blocky, moderately silty in part, non calcareous, moderately silty, moderately carbonaceous;
1043 - 1045	SILTSTONE - as above;
1045 - 1046	SHALE - dark gray, blocky, moderately silty in part, non calcareous, moderately carbonaceous;
1046 - 1050	SILTSTONE - as above;
1050 - 1051	SHALE - dark gray, blocky, moderately silty in part, non calcareous, moderately carbonaceous;
1051 - 1056	SILTSTONE - as above;
1056 - 1061	SILTSTONE - as above, very finely arenaceous, very argillaceous, moderately carbonaceous;
1061 - 1063	SHALE - dark gray, blocky, moderately silty in part, non calcareous, moderately carbonaceous;
1063 - 1064	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, rare glauconite, non calcareous, tight, moderately argillaceous, very silty;
1064 - 1065	SILTSTONE - as above, very argillaceous, moderately carbonaceous, moderately sandy;
1065 - 1068	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, no shows, tight, moderately argillaceous, very silty, moderately calcareous;
1068 - 1069	SILTSTONE - as above, very argillaceous, moderately carbonaceous, moderately sandy;
1069 - 1070	SHALE - as above, moderately carbonaceous;
1070 - 1071	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, no shows, tight, moderately argillaceous, very silty, moderately calcareous;
1071 - 1072	SILTSTONE - as above, very argillaceous, moderately carbonaceous, moderately sandy;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1072 - 1075	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, no shows, tight, moderately argillaceous, very silty, moderately calcareous;
1075 - 1079	SILTSTONE - medium dark gray to dark gray, as above, very argillaceous, moderately carbonaceous;
1079 - 1082	SANDSTONE - light medium gray to medium gray, very fine grained, subangular to angular, well sorted, trace to moderately glauconitic, non calcareous, tight, very argillaceous, very silty;
1082 - 1084	SILTSTONE - medium dark gray to dark gray, as above, very argillaceous, moderately carbonaceous;
1084 - 1085	SHALE - as above, moderately carbonaceous;
1085 - 1090	SILTSTONE - medium dark gray to dark gray, as above, very argillaceous, moderately carbonaceous;
1090 - 1093	SILTSTONE - increasingly argillaceous and shaley, moderately carbonaceous;
1093 - 1095	SHALE - dark gray, non calcareous, moderately carbonaceous;
1095 - 1096	SILTSTONE - as above, very argillaceous, moderately carbonaceous;
1096 - 1099	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, non to moderately calcareous cemented, tight, moderately argillaceous, very silty;
1099 - 1101	SILTSTONE - as above, very argillaceous, moderately carbonaceous;
1101 - 1105	SHALE - dark gray, non calcareous, moderately carbonaceous;
Scatter	<u>1105m Sample</u> <u>1099m Log</u>



# LITHOLOGY

Formation tops  
Sample interval  
(in meters)

## SAMPLE DESCRIPTION

1105 - 1118	<b>SANDSTONE</b> - light medium gray salt and pepper, very fine grained, subangular to angular, well sorted, no fluorescence, slow bluish cut, trace glauconite, non to moderately calcareous, no visible porosity, very silty, slightly carbonaceous;
1118 - 1119	<b>SILTSTONE</b> - medium dark gray, very fine, arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1119 - 1121	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;
1121 - 1122	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1122 - 1124	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;
1124 - 1126	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1126 - 1128	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;
1128 - 1131	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1131 - 1133	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;
1133 - 1138	<b>SANDSTONE</b> - light medium gray salt and pepper, very fine grained, subangular to angular, well sorted, no fluorescence, <u>very slow bluish cut</u> , trace glauconite, slightly calcareous, no visible porosity, very argillaceous, very silty;
1138 - 1140	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1140 - 1142	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1142 - 1144	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;
1144 - 1147	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, as above, increasingly silty and grading to siltstone, very argillaceous;
1147 - 1151	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1151 - 1152	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, as above, increasingly silty and grading to siltstone, very argillaceous
1152 -1153	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;
1153 - 1156	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, as above, increasingly silty and grading to siltstone, very argillaceous;
1156 - 1158	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1158 - 1159	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;
1159 - 1161	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1161 - 1163	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1163 - 1166	<b>SANDSTONE</b> - light medium gray salt and pepper, very fine grained, subangular to angular, well sorted, no fluorescence, <u>very slow bluish cut</u> , trace glauconite, slightly calcareous, no visible porosity, very argillaceous, very silty;
1166 - 1167	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1167 - 1168	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;
1168 - 1169	<b>SANDSTONE</b> - light medium gray salt and pepper, very fine grained, subangular to angular, well sorted, no fluorescence, <u>very slow bluish cut</u> , trace glauconite, slightly calcareous, no visible porosity, very argillaceous, very silty;
1169 - 1170	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1170 - 1172	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1172 - 1174	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, increasingly silty and grading to siltstone, very argillaceous;
1174 - 1175	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1175 - 1177	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;
1177 - 1178	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1178 - 1179	<b>SHALE</b> - dark gray, blocky, occasionally very finely arenaceous, moderately carbonaceous;

## LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1179 - 1183	<b>SILTSTONE</b> - medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1183 - 1191	<b>SANDSTONE</b> - light medium gray salt and pepper, very fine grained, subangular to angular, well sorted, trace glauconite, no shows, tight, moderately argillaceous, very silty;
1191 - 1192	<b>SILTSTONE</b> - medium dark gray, non calcareous, very argillaceous, moderately carbonaceous;
1192 - 1193	<b>SHALE</b> - dark gray, as above, very silty in part, moderately carbonaceous;
1193 - 1196	<b>SANDSTONE</b> - light medium gray salt and pepper, very fine grained, subangular to angular, well sorted, <u>trace dull yellow fluorescence, slow bluish cut</u> , non to very slightly calcareous, trace glauconite, no visible porosity, moderately argillaceous, very silty;
1196 - 1197	<b>SHALE</b> - dark gray, as above, very silty in part, moderately carbonaceous;
1197 - 1198	<b>SANDSTONE</b> - gray brown, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence, streaming bluish white cut</u> , non to moderately calcareous, no visible porosity, very argillaceous, very silty;
1198 - 1201	<b>SANDSTONE</b> - light medium gray salt and pepper, very fine grained, subangular to angular, well sorted, trace glauconite, no shows, tight, moderately argillaceous, very silty;
1201 - 1202	<b>SILTSTONE</b> - medium dark gray, non calcareous, very argillaceous, moderately carbonaceous;
1202 - 1213	<b>SANDSTONE</b> - light medium gray salt and pepper, medium gray, gray brown, very fine grained, subangular to angular, well sorted, <u>scattered dull yellow fluorescence and bluish white cut</u> where gray brown, slightly calcareous in part, scattered glauconite, slightly to moderately argillaceous, no visible porosity to <u>rare pinpoint porosity</u> , very silty, moderately carbonaceous;



# LITHOLOGY

Formation tops  
Sample interval  
(in meters)

## SAMPLE DESCRIPTION

1213 - 1215	SILTSTONE - medium dark gray, non calcareous, very argillaceous, moderately carbonaceous;
1215 - 1216	SANDSTONE - light medium gray salt and pepper, very fine grained, subangular to angular, well sorted, <u>trace dull yellow fluorescence, slow bluish cut</u> , non to very slightly calcareous, trace glauconite, no visible porosity, moderately argillaceous, very silty;
1216 - 1218	SILTSTONE - medium dark gray, non calcareous, very argillaceous, moderately carbonaceous;
1218 - 1220	SANDSTONE - gray brown, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence, streaming bluish white cut</u> , non to moderately calcareous, no visible porosity, very argillaceous, very silty;
1220 - 1223	SILTSTONE - medium dark gray, non calcareous, very argillaceous, moderately carbonaceous;
1223 - 1232	SANDSTONE - light medium gray salt and pepper, medium gray, gray brown, very fine grained, subangular to angular, well sorted, <u>scattered dull yellow fluorescence and bluish white cut</u> where gray brown, slightly calcareous in part, scattered glauconite, slightly to moderately argillaceous, no vis porosity to <u>rare pinpoint porosity</u> , very silty, moderately carbonaceous;
1232 - 1233	SHALE - dark gray, as above, very silty in part, moderately carbonaceous;
1233 - 1236	SANDSTONE - light medium gray to medium gray salt and pepper, very fine grained, subangular to angular, well sorted, as above, non visible porosity, moderately argillaceous, very silty;
Garbutt	1236m Sample      1235m Log
1236 - 1237	SILTSTONE - brown gray, <u>dull yellow fluorescence, blue white cut</u> , as above, tight, very argillaceous;
1237 - 1249	SILTSTONE - dark gray, shaley in part, very finely arenaceous in part, tight, very argillaceous, moderately carbonaceous;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1249 - 1254	<b>SILTSTONE</b> - dark gray, very shaley in part, non calcareous, very argillaceous, moderately carbonaceous;
1254 - 1255	<b>SHALE</b> - dark gray, non calcareous, moderately carbonaceous;
1255 - 1256	<b>SILTSTONE</b> - dark gray, very shaley in part, non calcareous, very argillaceous, moderately carbonaceous;
1256 - 1257	<b>SHALE</b> - dark gray, non calcareous, moderately carbonaceous;
1257 - 1258	<b>SILTSTONE</b> - dark gray, very shaley in part, non calcareous, very argillaceous, moderately carbonaceous;
1258 - 1265	<b>SILTSTONE</b> - dark gray to medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1265 - 1266	<b>SHALE</b> - dark gray, non calcareous, moderately carbonaceous;
1266 - 1267	<b>SILTSTONE</b> - dark gray to medium dark gray, very finely arenaceous in part, non calcareous, very argillaceous, moderately carbonaceous;
1267 - 1269	<b>SANDSTONE</b> - medium dark gray to dark gray, very fine grained, subangular to angular, well sorted, grading to very finely arenaceous sand, tight, very argillaceous, very silty;
1269 - 1277	<b>SILTSTONE</b> - dark gray, very shaley, non calcareous, very argillaceous, moderately carbonaceous;
1277 - 1280	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;
1280 - 1281	<b>SILTSTONE</b> - dark gray, very shaley, non calcareous, very argillaceous, moderately carbonaceous;
1281 - 1283	<b>SHALE</b> - dark gray, non calcareous, very silty, moderately carbonaceous;
1283 - 1284	<b>SILTSTONE</b> - dark gray, very shaley, non calcareous, very argillaceous, moderately carbonaceous;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1284 - 1325	SHALE - dark gray, non calcareous, very silty, moderately carbonaceous;
1325 - 1330	SILTSTONE - dark gray, very shaley, non calcareous, very argillaceous, moderately carbonaceous;
1330 - 1333	SANDSTONE - light medium gray salt and pepper to medium gray, very fine grained, subangular to angular, well sorted, <u>occasional dull yellow fluorescence with streaming milky white cut</u> , slightly to moderately argillaceous, non to moderately calcareous, scattered carbonaceous material, <u>rare pinpoint porosity</u> , very silty, scattered glauconite;
1333 - 1351	CORE #1 SEE DETAILED CORE DESCRIPTION
1351 - 1359	SHALE - very dark gray, non calcareous, occasional laminae of medium gray to medium brown gray very fine grained very argillaceous silty sandstone, very carbonaceous;
1359 - 1375	SHALE - very dark gray, non calcareous, medium gray and silty in part, grading to very argillaceous silt, very carbonaceous;
1375 - 1406	SHALE - very dark gray, non calcareous, very carbonaceous;
1406 - 1410	SHALE - very dark gray, non calcareous, very carbonaceous, occasionally silty;
Chinkeh	<u>1410m Sample</u> <u>1407m Log</u>
1410 - 1413	SANDSTONE - medium gray salt and pepper, medium green gray, very fine grained to fine grained, subangular to angular, well sorted, no apparent fluorescence, slow bluish cut, slightly siliceous cemented, slightly dolomitic cemented, <u>trace intergranular porosity</u> , very silty, abundant glauconite;
1413 - 1414	SHALE - very dark gray, non calcareous, very carbonaceous, occasionally silty;

LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1414 - 1422	<b>SANDSTONE</b> - medium gray salt and pepper, medium green gray, very fine grained to fine grained, subangular to angular, well sorted, no apparent fluorescence, slow bluish cut, slightly siliceous cemented, slightly dolomitic cemented, <u>trace intergranular porosity</u> , very silty, abundant glauconite;
1422 - 1425	<b>SHALE</b> - very dark gray, non calcareous, very carbonaceous, occasionally silty;
1425 - 1428	<b>SANDSTONE</b> - medium gray salt and pepper, medium green gray, very fine grained to fine grained, subangular to angular, well sorted, no apparent fluorescence, slow bluish cut, slightly siliceous cemented, slightly dolomitic cemented, <u>trace intergranular porosity</u> , very silty, abundant glauconite;
1428 - 1430	<b>SANDSTONE</b> - medium gray salt and pepper, very fine grained, subangular to angular, well sorted, slightly siliceous cemented, slightly dolomitic cemented, cut as above, no visible porosity, very silty, scattered glauconite;
1430 - 1432	<b>SHALE</b> - very dark gray, non calcareous, very carbonaceous, occasionally silty;
1432 - 1434	<b>SANDSTONE</b> - medium gray salt and pepper, very fine grained, subangular to angular, well sorted, slightly siliceous cemented, increasingly dolomitic cemented, cut as above, no visible porosity, trace glauconite;
1434 - 1435	<b>SHALE</b> - very dark gray, non calcareous, very carbonaceous, occasionally silty;
1435 - 1436	<b>SANDSTONE</b> - medium gray salt and pepper, very fine grained, subangular to angular, well sorted, slightly siliceous cemented, slightly dolomitic cemented, cut as above, no visible porosity, very silty, scattered glauconite;
1436 - 1438	<b>SHALE</b> - very dark gray, non calcareous, very carbonaceous, occasionally silty;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1438 - 1440	<b>SANDSTONE</b> - medium gray salt and pepper, very fine grained, subangular to angular, well sorted, slightly siliceous cemented, slightly dolomitic cemented, cut as above, no visible porosity, very silty, scattered glauconite;
1440 - 1443	<b>SHALE</b> - very dark gray, non calcareous, very carbonaceous, occasionally silty;
1443 - 1452	<b>SANDSTONE</b> - medium light gray, light medium gray salt and pepper, very fine grained, subangular to angular, well sorted, scattered dull yellow fluorescence, slow bluish cut, slightly to moderately dolomitic, rarely fine grained, no observable porosity, very silty;
1452 - 1453	<b>SHALE</b> - as above;
1453 - 1455	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, very silty, moderately dolomitic, occasional glauconite;
<u>Triassic(?)</u>	<u>1455m Sample</u> <u>1447m Log</u>
1455 - 1456	<b>SHALE</b> - as above;
1456 - 1457	<b>SILTSTONE</b> - medium light gray to light medium gray, slightly argillaceous, very finely arenaceous in part, slightly carbonaceous in part;
1457 - 1458	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, very silty, moderately dolomitic, occasional glauconite;
1458 - 1462	<b>SILTSTONE</b> - medium dark gray, very dolomitic, moderately argillaceous;
1462 - 1464	<b>SHALE</b> - brown, blocky, very dolomitic;
1464 - 1468	<b>SILTSTONE</b> - medium dark gray, moderately dolomitic;
1468 - 1469	<b>SHALE</b> - brown, blocky, very dolomitic;

### LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1469 - 1470	<b>SANDSTONE</b> - medium brown gray, light medium gray, very fine grained to fine grained, subangular to angular, well sorted, <u>trace dull yellow fluorescence with slow bluish cut</u> , moderately to very dolomitic cemented, no visible porosity, very silty;
1470 - 1471	<b>SHALE</b> - brown, blocky, very dolomitic;
1471 - 1472	<b>SILTSTONE</b> - medium dark gray, moderately dolomitic;
1472 - 1473	<b>SHALE</b> - brown, blocky, very dolomitic;
1473 - 1474	<b>SANDSTONE</b> - medium brown gray, light medium gray, very fine grained to fine grained, subangular to angular, well sorted, <u>trace dull yellow fluorescence with slow bluish cut</u> , moderately to very dolomitic cemented, no visible porosity, very silty;
1474 - 1475	<b>SILTSTONE</b> - medium dark gray, moderately dolomitic;
1475 - 1476	<b>SANDSTONE</b> - medium brown gray, light medium gray, very fine grained to fine grained, subangular to angular, well sorted, <u>trace dull yellow fluorescence with slow bluish cut</u> , moderately to very dolomitic cemented, no visible porosity, very silty;
1476 - 1479	<b>SHALE</b> - brown, medium to medium dark gray, slightly to moderately dolomitic;
1479 - 1485	<b>SILTSTONE</b> - medium dark gray, occasional interbeds of very fine grained very dolomitic cemented sandstone with no fluorescence and slow bluish cut, very dolomitic;
1479 - 1485	<b>SILTSTONE</b> - medium dark gray, interbedded with brown and medium dark gray dolomitic shales, very argillaceous, moderately dolomitic;
1485 - 1488	<b>SILTSTONE</b> - medium dark gray, moderately dolomitic;
1488 - 1489	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, <u>trace dull yellow fluorescence with slow bluish cut</u> , scattered carbonaceous material, tight, very dolomitic;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1489 - 1490	SILTSTONE - medium dark gray, moderately dolomitic;
1490 - 1491	SHALE - medium dark gray, slightly dolomitic, slightly silty, brown and moderately dolomitic in part;
1491 - 1493	SILTSTONE - medium dark gray, moderately dolomitic;
1493 - 1494	SANDSTONE - very fine grained, subangular to angular, well sorted, <u>trace dull yellow fluorescence and slow bluish cut</u> , scattered carbonaceous material, tight, very dolomitic;
1493 - 1494	SANDSTONE - medium brown gray, light medium gray, very fine grained to fine grained, subangular to angular, well sorted, <u>trace dull yellow fluorescence, slow bluish cut</u> , moderately to very dolomitic cemented, no visible porosity, very silty;
1494 - 1498	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, <u>rare dull yellow fluorescence with slow bluish cut</u> , moderately to very dolomitic, no visible porosity, very silty;
1498 - 1500	SILTSTONE - as above, moderately dolomitic;
1500 - 1506	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, increasingly silty and grading to very finely arenaceous silt, slightly argillaceous, no shows, no visible porosity, very silty, moderately dolomitic;
1506 - 1514	SILTSTONE - as above, very finely arenaceous in part, moderately dolomitic
1514 - 1515	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, increasingly silty and grading to very finely arenaceous siltstone, slightly argillaceous, no shows, no visible porosity, very silty, moderately dolomitic;
Belloy	1515m Sample      1517m Log
1515 - 1537	SHALE - brown, blocky, moderately dolomitic;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1537 - 1538	SANDSTONE - very fine grained, subangular to angular, well sorted, as above;
1538 - 1544	SHALE - brown, medium dark gray, as above, moderately dolomitic;
1544 - 1545	SILTSTONE - medium dark gray, as above, moderately dolomitic;
1545 - 1548	SHALE - brown, medium dark gray, as above, moderately dolomitic;
1548 - 1549	SILTSTONE - medium gray, as above, moderately dolomitic;
1549 - 1559	SHALE - brown, medium dark gray, blocky, rarely silty, moderately dolomitic;
1559 - 1562	SILTSTONE - medium gray, as above, moderately dolomitic;
1562 - 1564	SHALE - brown, medium dark gray, blocky, rarely silty, moderately dolomitic;
1564 - 1565	SILTSTONE - medium gray, as above, moderately dolomitic;
1565 - 1567	SANDSTONE - medium gray, very fine grained, subangular to angular, well sorted, no shows, interbedded with siltstone as above, moderately dolomitic;
1567 - 1573	SHALE - brown, medium dark gray, blocky, rarely silty, moderately dolomitic;
1573 - 1575	SANDSTONE - medium gray, very fine grained, subangular to angular, well sorted, grading to siltstone, tight, very silty, moderately dolomitic;
1575 - 1581	SHALE - brown, occasionally medium dark gray, as above, moderately dolomitic;
1581 - 1584	SHALE - medium dark gray, as above, moderately dolomitic;
<u>Fantasque</u>	<u>1584m Sample</u> <u>1571m Log</u>



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1584 - 1587	<b>SANDSTONE</b> - medium dark gray, fine grained, subangular to angular, well sorted, very rarely medium grained, no shows, no observable porosity, moderately argillaceous, moderately dolomitic, abundant glauconite;
1587 - 1589	<b>SILTSTONE</b> - medium dark gray, well consolidated, slightly siliceous cemented, moderately argillaceous;
1589 - 1590	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, as above, very well consolidated, siliceous cemented, no observable porosity, moderately argillaceous, moderately carbonaceous, trace pyrite;
1590 - 1593	<b>SILTSTONE</b> - medium dark gray, well consolidated, slightly siliceous cemented, moderately argillaceous;
1593 - 1598	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, very well consolidated, siliceous cemented in part, slightly to moderately dolomitic, rare cherty laminae, grading to dark gray siltstone, moderately argillaceous, very silty;
1598 - 1601	<b>SILTSTONE</b> - medium dark gray, well consolidated, slightly siliceous cemented, moderately argillaceous;
1601 - 1602	<b>SANDSTONE</b> - very fine grained, subangular to angular, well sorted, very well consolidated, siliceous cemented in part, slightly to moderately dolomitic, rare cherty laminae, grading to dark gray siltstone, moderately argillaceous, very silty;
1602 - 1603	<b>SILTSTONE</b> - medium dark gray, well consolidated, slightly siliceous cemented, moderately argillaceous;
1602 - 1603	<b>CHERT</b> - dark brown gray, rarely light medium gray, cryptocrystalline, massive with very fine grains of glauconite;
1603 - 1604	<b>SANDSTONE</b> - very fine grained to fine grained, subangular to angular, well sorted, as above, moderately carbonaceous, moderately argillaceous, moderately dolomitic;

**LITHOLOGY**

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1604 - 1606	<b>SILTSTONE</b> - medium dark gray, medium brown gray, slightly argillaceous, very finely arenaceous, dark brown gray and grading to silty dolomite in part, very cherty, moderately dolomitic;
1606 - 1608	<b>SANDSTONE</b> - very fine grained to fine grained, subangular to angular, well sorted, as above, moderately carbonaceous, moderately argillaceous, moderately dolomitic;
1608 - 1610	<b>CHERT</b> - dark brown gray, rarely light medium gray, cryptocrystalline, massive with very fine grains of glauconite;
1610 - 1611	<b>SILTSTONE</b> - medium dark gray, medium brown gray, slightly argillaceous, very finely arenaceous, dark brown gray and grading to silty dolomite in part, very cherty, moderately dolomitic, moderately sandy;
1611 - 1612	<b>CHERT</b> - dark brown gray, rarely light medium gray, cryptocrystalline, massive with very fine grains of glauconite;
1612 - 1614	<b>SILTSTONE</b> - medium dark gray, medium brown gray, slightly argillaceous, very finely arenaceous, dark brown gray and grading to silty dolomite in part, very cherty, moderately dolomitic;
1614 - 1617	<b>CHERT</b> - dark brown gray, rarely light medium gray, cryptocrystalline, massive with very fine grains of glauconite;
1614 - 1617	<b>CHERT</b> - dark brown gray, cryptocrystalline, massive with very fine glauconite grains, as above;
1617 - 1618	<b>SILTSTONE</b> - medium dark gray, as above, very cherty, moderately dolomitic;
1618 - 1619	<b>CHERT</b> - dark brown gray, cryptocrystalline, as above;
1619 - 1627	<b>CHERT</b> - gray black, dark brown gray on fresh surface, microcrystalline to very fine grained, no visible porosity, moderately dolomitic;



LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1627 - 1634	CHERT - gray black, dark brown gray on fresh surface, microcrystalline to very fine grained, trace pyrite, occasional very fine grained very glauconitic sandstone laminae, moderately dolomitic;
1634 - 1641	CHERT - microcrystalline to very fine grained, slightly argillaceous, as above, <u>very rare dull yellow fluorescence with slow bluish cut</u> , occasional very fine grained sandstone laminae, moderately dolomitic;
1641 - 1647	CHERT - microcrystalline to very fine crystalline, slightly argillaceous, occasional very fine grained sandstone laminae, moderately dolomitic;
1647 - 1654	CHERT - gray black, dark brown gray on fresh surface, microcrystalline to very fine grained, as above, moderately dolomitic;
1654 - 1656	CHERT - dark gray to dark brown gray, microcrystalline to very fine grained, as above, slightly dolomitic;
1656 - 1658	CHERT - dark gray to dark brown gray, microcrystalline to very fine grained, no visible fluorescence, slow bluish cut, slightly argillaceous, trace pyrobitumin, trace pyrite, rare sparry calcite and white dolomite fracture filling, <u>rare microvuggy porosity</u> ;
1658 - 1662	CHERT - dark gray to dark brown gray, microcrystalline to very fine grained, as above, slightly dolomitic;
1662 - 1666	CHERT - dark brown gray,, cryptocrystalline to very fine grained, slightly dolomitic, spiculer in part,, slightly dolomitic, rare white flinty fracture filling, <u>trace microvuggy and coarse grained fracture and solution porosity, dull yellow fluorescence with slow bluish cut</u> ;
1666 - 1668	SANDSTONE - dark brown gray, very fine grained, subangular to angular, well sorted, slightly dolomitic, very cherty in part, occasional pyrite, <u>trace microvuggy porosity</u> , moderately silty, occasional glauconite;

## LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1668 - 1674	<b>CHERT</b> - dark brown gray, light blue gray, cryptocrystalline to very fine grained, slightly dolomitic, rare flinty filled fractures, <u>very rare intercrystalline and microvuggy porosity</u> , occasional very fine grained cherty sandstone with <u>intergranular porosity</u> ;
1674 - 1676	<b>CHERT</b> - dark brown gray, cryptocrystalline to very fine grained, as above, with dark brown gray very fine grained moderately silty moderately to very dolomitic sandstone, <u>trace fracture and solution porosity</u> , <u>trace intergranular porosity</u> ;
1676 - 1678	<b>CHERT</b> - blue gray to dark brown gray, cryptocrystalline to very fine grained, as above, slightly dolomitic, with occasional fine to coarse grained sandstone fracture filling with <u>intergranular porosity</u> ;
1678 - 1679	<b>CHERT</b> - light blue gray, cryptocrystalline to very fine grained, as above, no visible porosity;
1679 - 1689	<b>CHERT</b> - medium brown gray to medium dark gray, medium blue gray, cryptocrystalline to very fine grained, <u>trace vuggy porosity</u> , <u>trace intergranular porosity</u> , <u>very rare dull yellow fluorescence with slow bluish cut</u> , as above, with dark brown gray carbonaceous moderately to very dolomitic moderately silty sandstone with <u>trace intergranular porosity</u> , <u>trace solution porosity</u> ;
1689 - 1692	<b>CHERT</b> - cryptocrystalline to very fine grained, non to moderately dolomitic where very fine grained, trace of fracture infilling, <u>trace microvuggy porosity</u> ;
1692 - 1694	<b>SANDSTONE</b> - medium brown gray, very fine grained, subangular to angular, well sorted, very slightly to moderately dolomitic, spiculer in part, grading to cherty siltstone, <u>trace solution porosity</u> , very silty;
1694 - 1696	<b>CHERT</b> - dark brown gray, occasionally blue gray, cryptocrystalline to very fine grained, as above, <u>trace microvuggy porosity</u> ;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1696 - 1699	SANDSTONE - dark brown gray, very fine grained, subangular to angular, well sorted, <u>rare dull yellow fluorescence with slow bluish cut</u> , as above, occasionally carbonaceous and pyrobituminous, <u>trace intergranular porosity</u> , very cherty, moderately dolomitic, very silty;
1699 - 1702	CHERT - dark brown gray, occasionally blue gray, cryptocrystalline to very fine grained, as above, <u>trace microvuggy porosity</u> ;
1702 - 1707	SANDSTONE - dark brown gray, very fine grained, subangular to angular, well sorted, <u>trace intergranular porosity</u> , <u>rare dull yellow fluorescence with slow bluish cut</u> , as above, occasionally carbonaceous and pyrobituminous, <u>trace intergranular porosity</u> , very cherty, moderately dolomitic, very silty;
1707 - 1709	CHERT - dark brown gray, trace fracture filling with very fine grained sandstone, as above;
1709 - 1718	SILTSTONE - very dark gray, no shows, tight, very argillaceous, moderately carbonaceous, very dolomitic;
1718 - 1721	CHERT - dark brown gray, trace fracture filling with very fine grained sandstone, as above;
Mattson	<u>1721m Sample</u> <u>1721m Log</u>
1721 - 1726	SANDSTONE - medium brown gray, very fine grained, subangular to angular, well sorted, slow bluish cut, scattered pyrobitumin, <u>rare intergranular porosity</u> , moderately dolomitic, moderately silty;
1726 - 1730	SANDSTONE - medium brown gray, light medium gray, very fine grained, subangular to angular, well sorted, slow bluish cut, as above, moderately to very calcareous, no visible porosity, moderately silty;
1730 - 1736	SANDSTONE - medium brown gray, light medium gray, very fine grained, subangular to angular, well sorted, <u>scattered dull yellow fluorescence with yellowish white cut</u> , as above, moderately pyrobituminous, no observable porosity to <u>rare intergranular porosity</u> , very calcareous, very silty;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1736 - 1737	SHALE - grayish green, blocky, non calcareous;
1737 - 1739	SANDSTONE - medium light gray, very fine grained, angular to subrounded, well sorted, <u>scattered dull yellow fluorescence with yellowish white cut</u> , slightly to very calcareous, scattered pyrobitumin, siliceous cemented, <u>scattered intergranular porosity</u> ;
1739 - 1741	SANDSTONE - medium light gray, very fine grained, angular to subrounded, well sorted, scattered pyrobitumin, siliceous cemented, as above, very calcareous, very silty;
1741 - 1742	SHALE - grayish green, blocky, non calcareous;
1742 - 1743	SANDSTONE - medium light gray, very fine grained, angular to subrounded, well sorted, scattered pyrobitumin, siliceous cemented, as above, very calcareous, very silty;
1743 - 1752	SANDSTONE - medium light gray, very fine grained to fine grained, angular to subrounded, well sorted, <u>dull yellow fluorescence with bluish cut</u> , siliceous cemented, very calcareous to dolomitic, very rare glauconite, rarely medium grained, <u>scattered good intergranular and intercrystalline porosity</u> with euhedral quartz crystals and overgrowths;
1752 - 1753	SILTSTONE - medium gray, siliceous cemented, occasionally grayish green and shaley, moderately dolomitic;
1753 - 1755	SANDSTONE - medium light gray, very fine grained to fine grained, angular to subrounded, well sorted, <u>dull yellow fluorescence with bluish cut</u> , siliceous cemented, very calcareous to dolomitic, very rare glauconite, rarely medium grained, <u>scattered intergranular porosity</u> ;
1755 - 1756	SILTSTONE - medium gray, siliceous cemented, occasionally grayish green and shaley, moderately dolomitic;
1756 - 1758	SANDSTONE - medium light gray, very fine grained to fine grained, angular to subrounded, well sorted, <u>dull yellow fluorescence with bluish cut</u> , siliceous cemented, very calcareous to dolomitic, very rare glauconite, rarely medium grained, <u>scattered intergranular porosity</u> ;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1758 - 1759	SILTSTONE - medium gray, siliceous cemented, occasionally grayish green and shaley, moderately dolomitic;
1759 - 1761	SANDSTONE - medium light gray, pale greenish gray in part, very fine grained, subangular to angular, well sorted, dull yellow fluorescence with slow bluish cut, slightly to moderately dolomitic, siliceous cemented, <u>very rare pinpoint porosity</u> , trace pyrite, rarely pyrobituminous with <u>dull yellow fluorescence and yellowish white cut</u> , as above;
1761 - 1762	SHALE - dark gray, blocky, very silty in part, moderately dolomitic;
1762 - 1763	SILTSTONE - medium gray, dark gray, as above, moderately dolomitic;
1763 - 1764	SANDSTONE - pale greenish gray, medium light gray, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with very slow bluish cut</u> , rare glauconite, siliceous cemented, scattered silt size pyrite, <u>rare intergranular porosity</u> , very silty, moderately dolomitic;
1764 - 1765	SHALE - dark gray, blocky, very silty in part, moderately dolomitic;
1765 - 1768	SANDSTONE - pale greenish gray, medium light gray, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with very slow bluish cut</u> , rare glauconite, siliceous cemented, scattered silt size pyrite, <u>rare intergranular porosity</u> , very silty, moderately dolomitic;
1768 - 1769	SILTSTONE - medium gray, dark gray, as above, moderately dolomitic;
1769 - 1770	SHALE - dark gray, blocky, very silty in part, moderately dolomitic;
1770 - 1771	SILTSTONE - medium gray, dark gray, as above, moderately dolomitic;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1771 - 1773	<b>SANDSTONE</b> - pale greenish gray, medium light gray, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with very slow bluish cut</u> , rare glauconite, siliceous cemented, scattered silt size pyrite, rare <u>intergranular porosity</u> , very silty, moderately dolomitic;
1773 - 1774	<b>SILTSTONE</b> - medium gray, dark gray, as above, moderately dolomitic;
1774 - 1777	<b>SHALE</b> - very dark gray, slightly dolomitic, slightly to moderately silty, moderately carbonaceous;
1777 - 1778	<b>SANDSTONE</b> - medium light gray, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with very slow bluish cut</u> , siliceous cemented, moderately silty, slightly dolomitic, moderately carbonaceous, very rare very fine to fine grained streaks with intergranular porosity;
1778 - 1780	<b>SHALE</b> - very dark gray, slightly dolomitic, slightly to moderately silty, moderately carbonaceous;
1780 - 1783	<b>SANDSTONE</b> - medium light gray, very fine grained, subangular to angular, well sorted, very calcareous to dolomitic cement, siliceous cement, as above, no shows, no observable porosity;
1783 - 1786	<b>SILTSTONE</b> - dark gray, moderately carbonaceous, moderately dolomitic, moderately argillaceous;
1786 - 1787	<b>SANDSTONE</b> - medium light gray, very fine grained, subangular to angular, well sorted, very calcareous to dolomitic cement, siliceous cement, as above, no shows, no observable porosity;
1787 - 1789	<b>SILTSTONE</b> - dark gray, moderately carbonaceous, moderately dolomitic, moderately argillaceous;
1789 - 1794	<b>SANDSTONE</b> - light medium gray, salt and pepper in part, very fine grained, subangular to angular, well sorted, <u>porosity, dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, slightly to moderately dolomitic, <u>trace intergranular porosity</u> in sample;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1794 - 1796	SHALE - medium gray to medium green gray, very silty in part, moderately dolomitic;
1796 - 1797	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, as above, slightly to moderately dolomitic, siliceous cemented, very silty;
1797 - 1798	SHALE - medium gray to medium green gray, very silty in part, moderately dolomitic;
1798 - 1799	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, as above, slightly to moderately dolomitic, siliceous cemented, very silty;
1799 - 1801	SILTSTONE - light medium gray, very siliceous cemented and cherty, very finely arenaceous and grading to silty sand, very cherty, moderately dolomitic;
1801 - 1802	SANDSTONE - medium light gray, light brown gray in part, pale greenish gray in part, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with very slow bluish cut</u> , very silty and grading to siltstone, no observable porosity, very cherty;
1802 - 1803	SHALE - as above, very dark gray and carbonaceous in part;
1803 - 1806	SANDSTONE - medium light gray, light brown gray in part, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , trace pyrite, siliceous cemented, cherty in part, trace shaley laminae, trace dolomitic kaolin laminae, <u>trace intergranular porosity</u> , moderately dolomitic;
1806 - 1807	SHALE - dark gray, non calcareous, moderately carbonaceous;
1807 - 1812	SANDSTONE - medium light gray, light brown gray in part, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , trace pyrite, siliceous cemented, cherty in part, trace shaley laminae, trace dolomitic kaolin laminae, <u>trace intergranular porosity</u> , moderately dolomitic;
1812 - 1813	SHALE - dark gray, non calcareous, moderately carbonaceous;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1813 - 1815	SANDSTONE - light gray, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, very rare coarse to very coarse chert grains in sample, <u>trace intergranular porosity</u> where very fine to fine grained, moderately dolomitic;
1815 - 1816	SANDSTONE - very fine grained to fine grained, subangular to angular, well sorted, as above, <u>trace intergranular porosity</u> , moderately dolomitic;
1816 - 1818	SANDSTONE - light medium gray, light brown gray, very fine grained, subangular to angular, well sorted, as above, moderately dolomitic;
1818 - 1820	SANDSTONE - light medium gray, light brown gray, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , moderately to very dolomitic, trace chert fragments in sample, <u>trace intergranular porosity</u> , moderately dolomitic;
1820 - 1822	SHALE - very dark gray, very silty and grading to very argillaceous siltstone in part, moderately carbonaceous;
1822 - 1825	SANDSTONE - light medium gray, light brown gray, very fine grained, subangular to angular, well sorted, as above, moderately dolomitic;
1825 - 1827	SILTSTONE - dark gray, moderately argillaceous, moderately dolomitic;
1827 - 1828	SANDSTONE - medium light gray salt and pepper, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, rarely fine grained, <u>trace intergranular porosity</u> , moderately dolomitic;
1828 - 1830	SILTSTONE - dark gray, very shaley in part, very finely arenaceous in part, moderately dolomitic, moderately argillaceous;
1830 - 1831	SHALE - dark gray, as above;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1831 - 1833	<b>SANDSTONE</b> - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, trace dolomitic kaolin laminae, <u>trace intergranular porosity</u> , moderately dolomitic;
1833 - 1834	<b>SILTSTONE</b> - dark gray, very shaley in part, very finely arenaceous in part, moderately dolomitic, moderately argillaceous;
1834 - 1835	<b>SHALE</b> - dark gray, as above;
1835 - 1840	<b>SANDSTONE</b> - medium light gray, light brown gray, very fine grained, occasionally very fine to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish cut</u> , siliceous cemented, <u>trace intergranular porosity</u> , moderately dolomitic;
1840 - 1841	<b>SHALE</b> - dark gray, as above;
1841 - 1842	<b>SILTSTONE</b> - medium to dark gray, brown gray and grading to shale, non calcareous, moderately carbonaceous;
1842 - 1846	<b>SANDSTONE</b> - medium light gray salt and pepper, light brown gray, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish cut</u> , siliceous cemented, slightly to moderately dolomitic, <u>scattered intergranular porosity</u> where fine grained, moderately dolomitic;
1846 - 1848	<b>SHALE</b> - dark gray, medium brown gray, non calcareous, moderately silty;
1848 - 1850	<b>SANDSTONE</b> - medium light gray salt and pepper, light brown gray, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish cut</u> , siliceous cemented, slightly to moderately dolomitic, <u>scattered intergranular porosity</u> where fine grained, moderately dolomitic;
1850 - 1853	<b>SHALE</b> - dark gray, silty in part, non calcareous, moderately carbonaceous, moderately silty;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1853 - 1856	SILTSTONE - dark gray, very argillaceous, moderately dolomitic;
1856 - 1860	SANDSTONE - medium light gray, light brown gray, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish white cut</u> , siliceous cemented, <u>scattered intergranular porosity</u> where very fine to fine grained, medium brown gray with pyrobitumin in part, moderately dolomitic;
1860 - 1861	SILTSTONE - dark gray, slightly to moderately pyrobituminous in part, very argillaceous, moderately dolomitic;
1861 - 1867	SILTSTONE - light medium gray, medium brown gray, no apparent fluorescence, bluish cut, non to very slightly dolomitic, bentonitic, very finely arenaceous in part, <u>trace microvuggy and moldic porosity</u> , very argillaceous;
1867 - 1869	SANDSTONE - light medium gray, very fine grained, subangular to angular, well sorted, dull yellow fluorescence with bluish cut, siliceous cemented, no observable to <u>very rare trace intergranular porosity</u> in sample, moderately dolomitic;
1869 - 1870	SILTSTONE - as above, <u>trace microvuggy and moldic porosity</u> ;
1870 - 1874	SANDSTONE - light brown gray to light yellow brown, occasional medium brown gray, very fine grained and some fine grained, subangular to angular, well sorted, <u>occasional dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, <u>trace intergranular porosity in part</u> , slightly dolomitic;
1874 - 1875	SILTSTONE - as above, <u>scattered microvuggy and moldic porosity</u> ;
1875 - 1880	SANDSTONE - light gray salt and pepper, light yellow brown to light brown gray, very fine grained to fine grained, subangular to angular, well sorted, <u>occasional dull yellow fluorescence with bluish cut</u> , siliceous cemented, slightly dolomitic, <u>trace to scattered intergranular porosity</u> ;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1880 - 1882	<b>SANDSTONE</b> - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, <u>scattered dull yellow fluorescence with bluish cut</u> , siliceous cemented, slightly dolomitic cemented, trace white slightly dolomitic kaolin laminae, <u>scattered intergranular porosity</u> ;
1882 - 1883	<b>SILTSTONE</b> - as above, <u>trace microvuggy and moldic porosity</u> ;
1883 - 1888	<b>SANDSTONE</b> - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, <u>scattered dull yellow fluorescence with bluish cut</u> , siliceous cemented, slightly dolomitic cemented, trace white slightly dolomitic kaolin laminae, <u>scattered intergranular porosity</u> ;
1888 - 1889	<b>SILTSTONE</b> - as above, <u>trace microvuggy and moldic porosity</u> ;
1889 - 1892	<b>SANDSTONE</b> - medium light gray salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, <u>scattered dull yellow fluorescence with bluish cut</u> , siliceous cemented, slightly dolomitic cemented, trace white slightly dolomitic kaolin laminae, <u>scattered intergranular porosity</u> ;
1892 - 1893	<b>SILTSTONE</b> - light medium gray, as above, dull yellow fluorescence with bluish cut, non calcareous, very argillaceous;
1893 - 1894	<b>SHALE</b> - dark gray, as above;
1894 - 1895	<b>SANDSTONE</b> - medium light gray salt and pepper, light yellow brown, light brown gray, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, non to slightly dolomitic, trace kaolin laminae, occasional subrounded fine grains, <u>trace intergranular porosity</u> ;
1895 - 1897	<b>SILTSTONE</b> - light medium gray, <u>dull yellow fluorescence with bluish cut</u> , non calcareous, very argillaceous;

LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1897 - 1901	SANDSTONE - light yellow brown, rarely medium yellow brown and pyrobituminous, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish cut</u> , siliceous cemented, slightly dolomitic, occasional carbonaceous laminae, <u>trace intergranular porosity</u> ;
1901 - 1903	SILTSTONE - as above, with <u>moldic and microvuggy porosity</u> , very argillaceous;
1903 - 1904	SANDSTONE - light yellow brown, rarely medium yellow brown and pyrobituminous, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish cut</u> , siliceous cemented, slightly dolomitic, occasional carbonaceous laminae, <u>trace intergranular porosity</u> ;
1904 - 1906	SILTSTONE - light medium gray, as above, non calcareous, very argillaceous;
1906 - 1909	CHERT - light yellow brown, cryptocrystalline, occasionally dolomitic, no observable porosity;
1909 - 1913	SANDSTONE - medium light gray salt and pepper, fine grained to medium grained, subangular to angular, well sorted, siliceous cemented, subrounded grains in part, <u>scattered good intergranular porosity</u> , moderately dolomitic;
1913 - 1916	CHERT - light yellow brown, occasionally bluish gray, cryptocrystalline, occasionally dolomitic, no observable porosity;
1916 - 1917	DOLOMITE - light to medium yellow brown, microcrystalline to finely crystalline, no shows, very finely arenaceous, no visible porosity, moderately cherty;
1917 - 1918	SANDSTONE - light gray salt and pepper, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , very siliceous cemented and cherty, no visible porosity;
1918 - 1919	CHERT - light yellow brown, cryptocrystalline, occasionally dolomitic, no observable porosity;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1919 - 1922	<b>DOLOMITE</b> - light to medium yellow brown, very finely crystalline to finely crystalline, very fine grained wackestone in part, as above;
1922 - 1925	<b>SANDSTONE</b> - light gray salt and pepper, light yellow brown salt and pepper, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , very siliceous cemented and cherty, very dolomitic in part and grading to very fine wackestone;
1925 - 1926	<b>CHERT</b> - cryptocrystalline to very fine grained, as above, trace dark gray and cryptocrystalline to microcrystalline, tight;
1926 - 1929	<b>SANDSTONE</b> - light yellow brown, salt and pepper in part, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, very slightly to moderately dolomitic, moderately cherty in part, no visible porosity, moderately silty;
1929 - 1930	<b>CHERT</b> - cryptocrystalline to very fine grained, as above, trace dark gray and cryptocrystalline to microcrystalline, tight;
1930 - 1932	<b>SANDSTONE</b> - light yellow brown, salt and pepper in part, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, very slightly to moderately dolomitic, moderately cherty in part, no visible porosity, moderately silty;
1932 - 1933	<b>CHERT</b> - cryptocrystalline to very fine grained, as above, trace dark gray and cryptocrystalline to microcrystalline, tight;
1933 - 1935	<b>SANDSTONE</b> - light yellow brown, medium light gray salt and pepper, medium dark brown, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence in part with slow bluish cut</u> , siliceous cemented, medium yellow brown pyrobituminous and very dolomitic in part, grading to very fine grained wackestone in part, no observable porosity;

LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1935 - 1936	<b>CHERT</b> - light to medium yellow brown, cryptocrystalline to very fine grained, grading in part to very fine grained, silty, cherty, sandstone;
1936 - 1938	<b>SANDSTONE</b> - light gray, light yellow brown, very fine grained and some fine grained, subangular to angular, well sorted, <u>rare dull yellow fluorescence with bluish cut</u> , very dolomitic and grading to very fine grained wackestone in part, cherty streaks, siliceous cemented, trace kaolin laminae, moderately cherty;
1938 - 1939	<b>CHERT</b> - light to medium yellow brown, cryptocrystalline to very fine grained, grading in part to very fine grained, silty, cherty, sandstone;
1939 - 1941	<b>SANDSTONE</b> - light gray, light yellow brown, very fine grained and some fine grained, subangular to angular, well sorted, <u>rare dull yellow fluorescence with bluish cut</u> , very dolomitic and grading to very fine grained wackestone in part, cherty streaks, siliceous cemented, trace kaolin laminae, moderately cherty;
1941 - 1945	<b>SANDSTONE</b> - as above, medium yellow brown in part, very fine grained to fine grained, subangular to angular, well sorted, medium yellow brown and argillaceous and slightly dolomitic in part, very rare streaks of medium to coarse grained, tight, moderately dolomitic, moderately cherty;
1945 - 1955	<b>SANDSTONE</b> - medium brown gray, very fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , very siliceous cemented, slightly dolomitic, occasional moderately argillaceous siltstone interbeds, very rare streaks of fine to medium grained, very cherty;
1955 - 1964	<b>SANDSTONE</b> - light yellow brown, dark yellow brown in part, very fine grained to fine grained, subangular to subrounded, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, very slightly dolomitic, trace kaolin laminae, <u>scattered intergranular porosity</u> ;
1964 - 1966	<b>SANDSTONE</b> - medium yellow brown, very fine grained, subangular to angular, well sorted, moderately dolomitic, no visible porosity, moderately silty, moderately cherty;



### LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1966 - 1974	<b>SANDSTONE</b> - light to medium yellow brown, very fine grained to fine grained, subangular to subrounded, well sorted, siliceous cemented, very slightly dolomitic, very fine grained and moderately dolomitic in part, silty in part, cherty in part, <u>scattered intergranular porosity</u> ;
1974 - 1976	<b>SANDSTONE</b> - light yellow brown, very fine grained, subangular to angular, well sorted, very siliceous and cherty in part with laminae of light to dark gray chert, occasional pyrite, tight, moderately dolomitic;
1976 - 1979	<b>SANDSTONE</b> - dark yellow brown, very fine grained to fine grained, subangular to angular, well sorted, siliceous cemented, slightly argillaceous, scattered pyrobitumin, <u>rare trace intergranular porosity</u> ;
1979 - 1980	<b>SILTSTONE</b> - dark gray, slightly dolomitic, moderately sandy, moderately argillaceous;
1980 - 1981	<b>SANDSTONE</b> - light medium gray, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, very slightly dolomitic, trace kaolin laminae, <u>scattered intergranular porosity</u> ;
1981 - 1982	<b>SILTSTONE</b> - dark gray, slightly dolomitic, moderately sandy, moderately argillaceous;
1982 - 1984	<b>SANDSTONE</b> - light medium gray, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence slow bluish cut</u> , siliceous cemented, very slightly dolomitic, trace kaolin laminae, <u>scattered intergranular porosity</u> ;
1984 - 1985	<b>SILTSTONE</b> - dark gray, slightly dolomitic, moderately sandy, moderately argillaceous;
1985 - 1987	<b>SANDSTONE</b> - medium dark gray, very fine grained, subangular to angular, well sorted, occasional dark gray carbonaceous shale laminae, moderately silty, very cherty, moderately argillaceous;
1987 - 1988	<b>SILTSTONE</b> - dark gray, slightly dolomitic, moderately sandy, moderately argillaceous;

# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
1988 - 1989	<b>SANDSTONE</b> - light medium gray, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with slow bluish cut</u> , siliceous cemented, very slightly dolomitic, trace kaolin laminae, <u>scattered intergranular porosity</u> ;
1989 - 1991	<b>SILTSTONE</b> - dark gray, slightly dolomitic, moderately sandy, moderately argillaceous;
1991 - 1992	<b>SILTSTONE</b> - dark gray to medium brown yellow, medium light gray in part, as above, moderately argillaceous, moderately sandy;
1992 - 1993	<b>CHERT</b> - light blue gray, dark brown, cryptocrystalline to very fine grained, moderately sandy;
1993 - 1994	<b>SILTSTONE</b> - dark gray to medium brown yellow, medium light gray in part, as above, moderately argillaceous, moderately sandy;
1994 - 1996	<b>SANDSTONE</b> - very fine grained to fine grained, subangular to angular, well sorted, as above, dark gray with abundant glauconite in part, <u>scattered intergranular porosity</u> ;
1996 - 1999	<b>SILTSTONE</b> - dark gray, moderately carbonaceous, very finely arenaceous and grading to very fine grained silty sandstone, moderately dolomitic, moderately argillaceous;
1999 - 2000	<b>SANDSTONE</b> - light yellow brown, light medium gray salt and pepper, very fine grained to medium grained, angular to subrounded, well sorted, siliceous cemented, moderately dolomitic and very fine grained in part, <u>trace intergranular porosity</u> where fine to medium grained;
2000 - 2008	<b>SANDSTONE</b> - light yellow brown, light medium gray salt and pepper, very fine grained to medium grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish cut</u> , siliceous cemented, very slightly dolomitic, subrounded medium grains, trace kaolin laminae, <u>trace to scattered intergranular porosity</u> ;
2008 - 2010	<b>SANDSTONE</b> - very fine grained to medium grained, subangular to subrounded, well sorted, as above, becoming cherty with cherty laminae;



# LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
2010 - 2012	SILTSTONE - dark gray, moderately carbonaceous, very finely arenaceous and grading to very fine grained silty sandstone, moderately dolomitic, moderately argillaceous;
2012 - 2013	SHALE - dark gray, non calcareous;
2013 - 2015	SILTSTONE - dark gray, cherty in part, moderately carbonaceous, moderately sandy, moderately dolomitic, moderately argillaceous;
2015 - 2016	CHERT - medium blue gray to dark gray, cryptocrystalline and some very fine grained, <u>trace microvuggy porosity</u> ;
2016 - 2017	SILTSTONE - dark gray, cherty in part, moderately carbonaceous, moderately sandy, moderately dolomitic, moderately argillaceous;
2017 - 2019	SANDSTONE - light yellow brown, light gray, salt and pepper in part, very fine grained to medium grained, subrounded to angular, well sorted, <u>dull yellow fluorescence with bluish cut in part</u> , siliceous cemented, <u>scattered intergranular porosity</u> ;
2019 - 2025	SANDSTONE - light yellow brown, light gray, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence in part with bluish cut</u> , medium yellow brown in part and pyrobituminous, becoming moderately to very dolomitic in part, <u>trace intergranular porosity</u> ;
2025 - 2030	SILTSTONE - dark gray, dark brown gray in part, moderately to very cherty, chert streaks, slightly to moderately dolomitic, occasional very dolomitic, very finely arenaceous in part, moderately cherty;
2030 - 2032	SANDSTONE - light to medium yellow brown, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish to milky white cut in part</u> , siliceous cemented, slightly to moderately dolomitic, cherty where medium yellow brown, <u>trace intergranular porosity</u> ;

## LITHOLOGY

Formation tops Sample interval (in meters)	SAMPLE DESCRIPTION
2032 - 2034	SILTSTONE - dark gray, dark brown gray in part, moderately to very cherty, chert streaks, slightly to moderately dolomitic, occasionally very dolomitic, very finely arenaceous in part;
2034 - 2037	SANDSTONE - light to medium yellow brown, light gray, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish cut</u> , slightly pyritic, cherty in part and occasional chert laminae, silty, moderately dolomitic;
2037 - 2038	SILTSTONE - dark gray, dark brown gray in part, moderately to very cherty, chert streaks, slightly to moderately dolomitic, occasionally very dolomitic, very finely arenaceous in part, moderately cherty;
2038 - 2039	SANDSTONE - very fine grained to fine grained, subangular to angular, well sorted, very dolomitic in part and grading to very fine grained wackestone in part, moderately cherty;
2039 - 2044	SANDSTONE - light gray, light yellow brown, medium yellow brown in part, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish cut</u> , slightly to moderately dolomitic, medium yellow brown and very dolomitic in part, trace pyrite, very cherty in part and scattered cherty laminae,
2044 - 2045	SANDSTONE - medium light gray salt and pepper, fine grained to medium grained, subrounded to angular, well sorted, siliceous cemented, slightly dolomitic, <u>trace intergranular porosity</u> in sample;
2045 - 2046	SANDSTONE - light gray, light yellow brown, medium yellow brown in part, very fine grained to fine grained, subangular to angular, well sorted, <u>dull yellow fluorescence with bluish cut</u> , slightly to moderately dolomitic, medium yellow brown and very dolomitic in part, trace pyrite, very cherty in part and scattered cherty laminae;
TOTAL DEPTH	2046m Driller      2045m Logger



### GEOLOGICAL SUMMARY AND CONCLUSIONS

Paramount et al Liard A-01 located at 60° 00' 05" 123° 15' 05" was spudded on February 9, 1999 at 05:30 hours.

Liard A-01 was drilled to test the Lower Cretaceous Chinkeh sandstone for gas, and the Permian Fantasque and Mattson sands for the presence of oil or gas.

The well location was on the southeast end of a plunging structure characterized by the presence of a thrust fault.

A wellsite geologist was on location from spud to T.D. Sample collection began at surface. 2 sets of vialled samples were collected and washed for the National Energy Board and 1 set of vialled samples was collected and washed for Paramount Resources Ltd. Additional bagged samples were collected for the National Energy Board.

A Continental Laboratories Minipac 2100 gas detection system was set up and operated from spud to T.D.

A 311mm pilot hole was drilled to 501 metres. This hole was enlarged to 445mm to 503 metres and 38 joints of 339.7mm surface casing ran and landed at 503 metres.

The mud system was converted to a calcium chloride invert system and drilling 222mm hole commenced at 15:40 hrs., February 17, 1999.

The Scatter appeared to come in at 982 metres (-459). Prognosed top of the Scatter was 971 metres (-448). No significant shows were encountered in the Scatter.

The top of the Garbutt was tentatively picked at 1101 metres (-578). Prognosed top of the Garbutt was 1107 metres (-584).

The decision was made to attempt to core the Chinkeh/Triassic formation. The Chinkeh top was picked at 1330 metres (-807) based on a penetration rate change and sample description of a light medium gray salt and pepper, very fine grained, silty sandstone with streaks of abundant glauconite occasional dull yellow fluorescence with streaming milky white cut, and very rare pinpoint porosity. No increase in gas readings occurred. Core #1 was cut from 1333.0 metres to 1351.2 metres with 100% recovery. The core contained 3 thin sandstone units with a total thickness of 1.65 metres. Only rare pinpoint porosity was observed in the core.

The core recovery indicated the section may have thickened in this location and probably did not represent the Chinkeh/Triassic despite the similarity of the lithology. Drilling continued. The Chinkeh was re-picked from drilling rate and samples at 1410 metres. Prognosed top of the Chinkeh



### GEOLOGICAL SUMMARY AND CONCLUSIONS (cont.)

was 1293 metres (-770). Penetration rate went from 8.1 minutes/metre to 10-13.1 minutes/metre and gas decreased from 8 units to 4-5 units. This suggested the Chinkeh was wet. Lithology was a medium gray salt and pepper very fine to fine grained, medium greenish gray in part, siliceous cemented, slightly dolomitic cemented, very silty, with abundant glauconite, and trace intergranular porosity. Isopaching up from the Chinkeh put the Garbutt at 1236 metres (-713).

The top of the Triassic was tentatively picked at 1425 metres (-902). Prognosed top of the Triassic was 1304 metres (-781). The Triassic was later re-picked at 1455 metres (-932) based on penetration rate change and lithology change from very fine grained sandstone to siltstone and brown shale.

The top of the Belloy was picked at 1515 metres (-992). Prognosed top of the Belloy was 1441 metres (-918). Lithology went from a medium dark gray, moderately dolomitic, very finely arenaceous siltstone to a brown, moderately dolomitic shale.

The top of the Fantasque was tentatively picked at 1584 metres based on the change in lithology from a medium dark gray, moderately dolomitic shale to a medium dark gray, very fine to fine grained, moderately argillaceous, moderately dolomitic sandstone with abundant glauconite. No porosity was observed in samples to 1654 metres.

Background gas readings were low in this hole. Background gas was 4 to 30 units. There were no large increases in gas readings from surface to 2030 metres. The gas detection system was function tested regularly with butane test gas. These tests indicated the system would respond to increases in gas in the mud system. A new gas detector with slightly greater sensitivity was installed on February 27th at 1654 metres prior to entering the Mattson formation.

At 1648 metres deviation increased to 3.50 degrees. It was decided to pull out of the hole at 1654 metres to run directional tools in order to control the deviation problem. When pulled the bit was undergauge and missing 2 cones. After a mill run, and several magnet runs the cones and bearing holders were recovered.

Drilling continued with directional tools. The Fantasque cherts displayed evidence of microvuggy, solution, and fracture porosity from 1656 metres to 1707 metres. There were occasional spotty oil shows in the interval 1679 metres to 1689 metres. Drilling rate varied considerably when directional tools were used and was often not reflective of lithology or porosity as weight on bit (WOB) and revolutions per minute (RPM) changed depending on whether pipe was rotating or sliding.



### GEOLOGICAL SUMMARY AND CONCLUSIONS (cont.)

The Mattson was picked at 1721 metres (-1198) based on samples. Prognosed top of the Mattson was 1595 metres (-1072). The top of the Mattson was marked by a change from dark brown cherts and dark gray, very dolomitic siltstones of the Fantasque formation to medium brown gray, very fine to fine grained, calcareous, sandstone. There was scattered dull yellow fluorescence with yellowish white cut in samples from 1730 metres to 1739 metres. There was scattered intergranular porosity in this interval. Gas increased from 7 units to 31 units over the interval 1737 metres to 1739 metres.

A good drilling break occurred from 1743 metres to 1747 metres. Penetration rate went from 24.3 minutes/metre to 5.2 -13.6 minutes/metre; however, gas readings decreased from 10 units to 7 units. Lithology was a medium light gray, very fine to fine grained, very calcareous to dolomitic, siliceous cemented sandstone, with scattered dull yellow fluorescence with weak bluish cut, and good intergranular and intercrystalline porosity. The sand showed much evidence of recrystallization with quartz overgrowths and euhedral crystal development.

The interval from 1831 metres to 1833 metres produced a penetration rate change from 36.1 minutes/metre to 23-24.5 minutes/metre and a gas reading increase from 4 to 7-10 units. Over the interval 1835 metres to 1840 metres penetration rate increased from 36.5 minutes/metre to 10.2-21 minutes/metre and gas readings increased from 10 units to 13 units. Lithology was very fine to fine grained, siliceous cemented, moderately dolomitic sandstone with dull yellow fluorescence, slow bluish cut, and trace intergranular porosity.

From 1842 metres to 1846 metres the drilling rate increased from 17.3 to 4.0-11.5 minutes/metre. Gas readings increased from 8 to 10 units. Of note was the trip gas of 50 units after the trip at 1751 metres and several connection gases of 24-32 units after the penetration of this zone. This was the first evidence of trip or connection gas encountered in this hole. Lithology was a medium light gray salt and pepper to light brown gray, very fine to fine grained sandstone, siliceous cemented, slightly to moderately dolomitic cemented, with dull yellow fluorescence and bluish cut. The sample showed scattered intergranular porosity where sand is fine grained.

The interval 1867 metres to 1869 metres produced a drilling break from 55.4 minutes/metre to 19.3-14.5 minutes/metre. Gas increased slightly from 15 to 20 units. Lithology was a light medium gray, very fine grained sandstone, siliceous cemented, moderately dolomitic, with dull yellow fluorescence, bluish white cut, and traces of intergranular porosity.

The very argillaceous siltstone interbeds from 1853 metres to 1906 metres produced no drilling breaks or gas increases but exhibited scattered microvuggy and moldic porosity.



### GEOLOGICAL SUMMARY AND CONCLUSIONS (cont.)

The interval from 1876 metres to 1892 metres showed a penetration rate increase from 33.5 minutes/metre to 7.7-24.7 minutes/metre. Gas readings did not increase and ran 10-18 units. The sandstone was usually very fine grained to fine grained, siliceous cemented, very slightly dolomitic, with a dull yellow fluorescence and bluish cut. The sands in this interval showed fair to good intergranular porosity in samples.

At 1908 metres to 1909 metres lithology changed from sandstone to light yellow brown, occasionally dolomitic, cryptocrystalline, chert with no shows and no visible porosity. A good drilling break occurred from 1909 metres to 1913 metres with penetration rate change to 6.5-1.7 minutes/metre. There was no increase in gas readings over this interval and no indication of gas or water influx in the drilling fluid. Samples showed 10% medium gray salt and pepper, very fine to medium grained, sandstone with good intergranular porosity (10-15%) where fine to medium grained.

It was decided to test the above drilling break interval. DST #1, a bottom hole conventional test, was run over the interval 1906 metres to 1917 metres. Times were 10-3-15-60-60-120. The preflows produced strong air blows with no gas to surface. Real time indicated test tool plugged 5 minutes into the first preflow. The test continued with a initial shut in of 60 minutes, a valve open of 60 minutes, and a final shut in of 120 minutes. The valve open produced a weak air blow throughout. Field pressures were taken from Delta P real time charts as downhole recorder charts could not be field read due to tool plugging. The highest flow pressure recorded was the 2nd IPF pressure of 17982 kPa. The FF pressure was 175541 kPa. FSI pressure was 17574 kPa. The recovery was 660 metres of fluid. The top 108 metres of the recovery was invert and salty water. The bottom 552 metres was salty water. It was decided not to attempt another DST of this zone as Baker Atlas advised they had enough data to do a Horner plot. The test indicated this interval would produce salty water.

Drilling continued to 1935 metres. T.D. was called AT 05:30 hrs. on March 11, 1999.

Logs were run using Baker Atlas. Logger's T.D. was 1930.6 metres. The following logs were run: HDIL-GR (1928.1 metres to 502.0 metres); ZDL-CNL-GR-XYCAL ( 1929.2 metres to 502.0 metres); XMAC-GR (1925.0 metres to 502.0 metres). The loggers experienced some processing problems with the sonic tool; otherwise the equipment performed well. Logger's depths appeared to be 3 metres above driller's depths when comparisons were made with drilling breaks and lithology.

Based on log response and sample descriptions it was decided to run 5 straddle inflate drillstem tests.



### GEOLOGICAL SUMMARY AND CONCLUSIONS (cont.)

DST #2 was run in the Mattson over the interval 1865 metres to 1892 metres. The preflows produced a weak air blow throughout and packer seat was lost 2 minutes into the ISI. The test was discontinued. Recovery was 215 metres of invert drilling fluid. Real time showed an IPF pressure of 241 kPa and a FPF pressure of 418 kPa. The ISI pressure at 2 minutes was 4220 kPa. Baker Atlas advised that there was enough information on the charts to do a Horner plot.

DST #3 was run in the Mattson over the interval 1819 metres to 1848 metres. Times were 10-60-120-240. The Preflow produced a weak air blow increasing to strong air blow in 30 seconds, gas to surface in 6.5 minutes, and a lazy 3 metre flare on a 6.35mm choke. IPF pressure was 534 kPa and FPF pressure was 855 kPa. ISI pressure was 15044 kPa. A VO of 120 minutes produced a lazy 1.5 metre flare through a 3.175mm choke. 60 kPa of pressure at the floor manifold indicated a flow of 214m<sup>3</sup>/day (7557ft<sup>3</sup>/day). Recovery was 100 metres of gassy invert and 100 metres of gassy water cut invert. A sample caught just above the tool was water with a salinity of 34000ppm CL. The test indicated a gas reservoir which produces water.

DST #4 was run in the Mattson over the interval 1781 metres to 1804.4 metres. Times were 10-60-180-360. The preflow produced a WAB to FAB in 10 minutes with no gas to surface. The VO produced a strong initial surge followed by a WAB. As the WAB increased to a FAB the VO time was increased to 180 minutes. There was no gas to surface. IPF pressure was 253 kPa and FPF pressure was 338 kPa. IF pressure on VO was 239 kPa with FF pressure of 297 kPa. ISI pressure was 763 kPa and FSI pressure was 2391 after 360 minutes. Recovery was 10 metres of gassy invert. The test indicated a low permeability reservoir.

DST #5 was run in the Chinkeh over the interval 1405 metres to 1429 metres. Times were 10-60-120-240. The preflow and valve opened both produced a very weak air blow with no gas to surface. ISI pressure was 10900 kPa. FSI pressure was 10903 kPa. IF pressure on VO was 283 kPa and FF pressure was 652 kPa. Recovery was 45 metres of invert. The test indicated a low permeability reservoir.

DST #6 was run in the Fantasque over the interval 1668 metres to 1698 metres. A 10 minute preflow produced a WAB increasing to SAB in 2.5 minutes. There was no gas to surface. After an ISI of 60 minutes the tool was opened for 120 minutes. VO produced a WAB increasing to SAB in 2 minutes with GTS in 30 minutes. The gas flow was TSTM. IPF pressure was 610 kPa with a FPF pressure of 1075 kPa. ISI pressure was 15104 kPa. IF pressure was 1239 kPa and FF pressure 5134 kPa. FSI pressure was 15071 kPa. The fluid recovery of 490 metres consisted of 90 metres of gassy invert, 200 metres of gassy invert slightly contaminated with salt water, and 200 metres of gassy salt water (50000ppm Cl). The test indicated a permeable reservoir which would produce gas and salt water



### GEOLOGICAL SUMMARY AND CONCLUSIONS (cont.)

The decision was made to drill deeper to 2000 metres to evaluate the next few Mattson sands.

A drilling break from 49 minutes/metre to 4-5.6 minutes/metre occurred over the interval 1955 metres to 1962 metres. Gas readings increased from 8 to 21 units and samples indicated a light yellow brown, very fine to fine grained sandstone, with scattered good intergranular porosity

A penetration rate change from 46 minutes/metre to 25 minutes/metre over the interval 1999 metres to 2000 metres produced a gas increase from 18 to 42 units. Samples showed a trace of fine to medium grained sandstone with intergranular porosity.

Rather than stop drilling at 2000 metres the decision was made to drill ahead to make enough overhole to show the above sandstone on logs.

Several additional drilling breaks with small gas increases occurred from 2000 metres to 2030 metres. From 2030 metres to 2031 metres the penetration rate went from 41.6 minutes/metre to 11.7 minutes/metre. Gas readings increased from 18 units to 172 units. Samples indicated a very fine to fine grained sandstone with dull yellow fluorescence, rare milky white cut, and trace of intergranular porosity. The magnitude of the gas detector response was larger than had previously been encountered in the hole and the decision was made to continue drilling to ensure this zone showed up on logs. Background gas went from 18 to 20 units before penetration of the above zone to 45 to 55 units. Connection gas readings also appeared for the first time in the hole.

At 2044 metres to 2045 metres penetration rate went from 38.0 minutes/metre to 25 minutes/metre and gas increased from 43 to 113 units. Lithology was a very fine to fine grained sandstone with streaks of fine to medium grained with intergranular porosity.

Drilling was stopped and TD called at 2046 metres on March 19, 1999 at 20:20 hrs. because of the number of hours on the bit and drop in penetration rate.

The following logs were run using Baker Atlas equipment. Logger's TD was 2044.8 metres. The following logs were run: HDIL-GR (2042.3 metres to 1925.0 metres); ZDL-CNL-GR-XYCAL (2043.7 metres to 1925.0 metres); MAC-GR-CAL (2041.2 metres to 1925.0 metres).

Based on log response, sample description, and gas detector response several zones appeared to be candidates for testing.



### GEOLOGICAL SUMMARY AND CONCLUSIONS (cont.)

DST #7, a bottom hole inflate, was run over the interval 2028 metres to 2046 metres. A preflow of 10 minutes produced a WAB increasing to SAB in 30 seconds then decreasing to FAB to end of PF with no gas to surface. IPF pressure was 452 kPa. FPF pressure was 611 kPa. An ISI of 60 minutes produced an ISI pressure of 2732 kPa. VO was 120 minutes with a WAB increasing to SAB in 30 seconds to a SAB for 4 minutes then decreasing to FAB to end of VO. There was no gas to surface. IF pressure was 376 kPa. FF pressure was 735 kPa. A FSI of 240 minutes produced a FSI pressure of 4693 kPa.

DST #8 over the interval 1955 metres to 1965 metres was declared a misrun due to blown bottom packer. DST #9 over the same interval produced a WAB on preflow with NGTS. The packer failed at 8 minutes into the PF. IPF pressure was 581 kPa and FPF pressure was 2811 kPa.

The decision was made to run 177.8mm casing to the bottom of the hole.

SUMMARY OF DRILLING BREAKS AND GAS INCREASES

Interval	Formation	P.R. Change(min/m)	Gas Change(units)	Lithology
166-69	Lepine	2.5 to 2.2-2.3	4 to 5	CGL/tr ig por
183-19	Lepine	2.5 to 1.7-3.4	3-4 to 4-8	CGL/ig por
243-59	Lepine	8.5 to 3.6-4.5	5 to 3-4	SS/scat ig por
259-67	Lepine	6.0 to 3.8-4.6	3 to 4	CGL/g ig por
349-53	Lepine	7.9 to 3.8-7.5	5 to 4	SS/tr ig por
1102-03	Garbutt	8.4 to 11	22 to 21	SS/os/tt
1204-06	Garbutt	9.8 to 10.5	22 to 36	SS/os/rr pp por
1218-20	Garbutt	10.5 to 7.2-8.5	18 to 16	SS/os/ tt
1223-32	Garbutt	11.1 to 7.1-8.4	26 to 16 to 23	SS/os/rr pp por
1330-33	Garbutt	5.1 to 7-10.4	13 to 10-12	SS/os/rr pp por
1410-22*	Chinkeh	8.1 to 10-13.1	8 to 4-5	SS/tr ig por
1649-52	Fantasque	28.6 to 15.6-17.7	17 to 26	CHT/n ob por
1656-58	Fantasque	20.6 to 9.9-10.4	10 to 11	CHT/mv por
1662-78*	Fantasque	23 to 7.6-13.6	13 to 24	CHT/mv/frc/ig
1669-71*	Fantasque	12.3 to 9.8-13.6	20 to 29-34	CHT/tr mv/xl
1679-89*	Fantasque	24.5 to 20.4-33.2	17 to 15-28	CHT/tr mv por
1692-94*	Fantasque	34.4 to 20.9-24.8	27 to 74(0.2m)	SS/tr sol por
1696-99	Fantasque	52.7 to 20.2-29.7	25 to 10	SS/tr ig por
1702-07	Fantasque	57.6 to 27.4-38	11 to 10-14	SS/tr ig por
1721-24	Mattson	31.5 to 18.8-13.0	29 to 57-14	SS/rr ig por
1730-36	Mattson	58.5 to 25.6-20.0	10 to 8	SS/os/n ob por
1737-39	Mattson	29.4 to 20.2	7 to 31-14	SS/os/ig por
1743-47	Mattson	24.3 to 5.2-13.6	10 to 7	SS/good ig por
1750-52	Mattson	22.0 to 14.6-15.1	6 to 6-7	SS/scat ig por
1753-54	Mattson	27.9 to 19	8 to 4	SS/scat ig por
1756-58	Mattson	28.2 to 20.3-24	7 to 4	SS/scat ig por
1789-94*	Mattson	49.8 to 8.7-27.2	7 to 6-7	SS/tr ig por
1803-06*	Mattson	28.7 to 19-22.8	4 to 8	SS/tr ig por
1807-12	Mattson	28.8 to 14.4-22.2	4 to 6-8	SS/tr ig por
1815-16	Mattson	21.5 to 16.3	3 to 4	SS/tr ig por
1818-20*	Mattson	22.8 to 12.4-13.5	4 to 4-7	SS/tr ig por
1827-28*	Mattson	21.9 to 17.5	4 to 6	SS/tr ig por
1831-33*	Mattson	36.1 to 23-24.5	4 to 7-10	SS/tr ig por
1835-40*	Mattson	36.5 to 10.2-21	10 to 13	SS/tr ig por
1842-46*	Mattson	17.3 to 4-11.5	8 to 10	SS/scat ig por
1848-50	Mattson	46.3 to 13.4-19.8	8 to 4-6	SS/scat ig por
1853-56	Mattson	34.4 to 26.4-30.8	14 to 8-13	SLT/mv/mld por
1856-58	Mattson	26.8 to 19-20.6	13 to 10-11	SS/os/scat por
1867-69*	Mattson	55.4 to 14.5-19.3	15 to 20	SS/tr ig por
1876-92*	Mattson	33.5 to 7.7-30.7	15 to 13-18	SS/scat ig por



SUMMARY OF DRILLING BREAKS AND GAS INCREASES

Interval	Formation	P.R. Change(min/m)	Gas Change(units)	Lithology
1894-95	Mattson	39.2 to 22.2	11 to 10	SS/scat ig por
1897-01	Mattson	35.3 to 25.7-21.2	10 to 7-10	SS/tr ig por
1903-04	Mattson	35.0 to 20.6	10 to 8	SS/tr ig por
1906-08*	Mattson	30.8 to 24.1-26.4	10 to 8	SS/tr ig por
1909-13*	Mattson	<b>40.2 to 1.7-6.5</b>	<b>13 to 10-13</b>	SS/g ig por
1955-62	Mattson	<b>49 to 4-5.6</b>	<b>8 to 17-21</b>	SS/g ig por
1968-71	Mattson	29.7 to 9.6-17.9	14 to 15 units	SS/scat ig por
1972-73	Mattson	26.9 to 9.6	13 to 14	SS/os/scat por
1980-84	Mattson	31.1 to 22.3-29.6	18 to 14-15	SS/scat ig por
1988-89	Mattson	34.3 to 23.2	17 to 20	SS/scat ig por
1999-00	Mattson	<b>45.8 to 24.7</b>	<b>18 to 42</b>	SS/tr ig por
2002-08	Mattson	28.2 to 6.2-13.8	22 to 20-29	SS/scat ig por
2017-19	Mattson	<b>38.8 to 14.2-21.1</b>	<b>14 to 43-24</b>	SS/scat ig por
2030-31	Mattson	<b>41.6 to 11.7</b>	<b>18 to 172</b>	SS/tr ig por
2044-45	Mattson	<b>38.0 to 25</b>	<b>43 to 113</b>	SS/tr ig por

NOTE: Significant intervals are in bold type.

Gas readings are maximum reading in the interval.

os indicates significant fluorescence and cut.

Directional drilled hole from 1654m to 1917m.

\*indicates interval was tested.

DST #1 (1906m to 1917m). Partial misrun. NGTS. Recovered 660m of salty water.

DST #2 (1865m to 1892m). Misrun. Recovered 15m of invert.

DST #3 (1819m to 1848m). GTS. 214m<sup>3</sup>/day. Recovered 100m of gassy invert and 100m of gassy salt water cut invert.

DST #4 (1781m to 1804.4m). NGTS. Recovered 10m of gassy invert.

DST #5 (1405m to 1429m). NGTS. Recovered 45m of invert.

DST #6 (1668m to 1698m). GTS. TSTM. Recovered 290m of contaminated invert and 200m of salt water.

DST #7 (2028m to 2046m). NGTS. Recovered 62m of gasified invert.

DST #8 (1955m to 1965m). Misrun.

DST #9 (1955m to 1965m). NGTS. Recovered 100m of gasified invert, 50m of water cut invert, and 115m of salt water.



