

CONFIDENTIAL

WELL HISTORY REPORT

S.O.B.C. BLACKSTONE Y.T. D-77

Unit D Section 77 Grid 65° 50'; 137° 00'



THE CALIFORNIA STANDARD COMPANY

11605 - 118 Ave., Edmonton, Alberta.

WELL HISTORY REPORT

S.O.B.C. BLACKSTONE Y.T. D-77

Unit D Section 77 Grid 65° 50'; 137° 00'

DATE:

May 6, 1963

SIGNED

R.C. Richardson P. Eng.

R.C. RICHARDSON

District Superintendent

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WELL HISTORY REPORT

Section I - Summary of Well Data

- a) Well name - S.O.B.C. BLACKSTONE Y.T. D-77
- b) Permittee - The California Standard Company
Medical Arts Building
Calgary, Alberta
- Licencee - The Standard Oil Company of British Columbia
Medical Arts Building
Calgary, Alberta
- c) Operator - The Standard Oil Company of British Columbia
Medical Arts Building
CALGARY, Alberta
- d) Location - Unit D Section 77 Grid 65°50'; 137°00'
- e) Co-ordinates - Latitude 65°46' - 10.77"N -
Longitude 137°14' 54.78"W
- f) Permit number - #1073
- g) Drilling Contractor - Trinity Canadian Drilling Rig # 5
142' Lee C Moore derrick
- h) Drilling Authority - # 109 Issued January 3, 1962
- i) Classification - New Field Well
- j) Elevations - Ground - 2100' K.B. - 2116
- k) Spudded - March 10, 1962
- l) Completed drilling - November 20, 1962
- m) Total depth - 13,217'
Plugged back to surface
- n) Well status - Abandoned
- o) Rig released - 10:00 AM Y.S.T., January 8, 1963
- p) Hole size - 24" surface to 204'
17 1/2" 204' to 1980'
12 1/4" 1980' to 5303'
8-5/8" 5303 to T.D.
- q) Casing
- | Size | Type | Weight | Set at | Sax of cement |
|--------|----------------|-------------|----------|---------------|
| 20" | H-40 | 94# | 199.64' | 350 |
| 13-3/8 | J-55 | 54# | 1971.58' | 1080 |
| 9-5/8 | N-80 &
J-55 | 40 &
36# | 5301.0' | 1260 |

Section II - Geological Summary

a) Formation Tops

Markers	Depth (Sample)	Depth (IES or SGR)	Elevation (IES or SGR)
? Pennsylvanian Limestone	1430	1430	+ 286
Mississippian Shale	1530	1525	+ 166
Fort Creek Shale	2690	2703	- 987
Middle Devonian Limestone	3610	3614	-1898
Middle Devonian Dolomite	4745	4747	-3031
Blackstone R. (M. Dev) Dolomite	5770	5747 (ML)	-4031
Lower Devonian Limestone & Shale	7165	7170	-5454
Silurian Shale & Limestone ?	8920	? 8918	? -7202
Upper Ordovician Limestone	9280	9280	-7564
Ordovician Dolomite	9492	9494	-7778
TD in Dolomite	13217	13202	-11486
	(Driller)	(Schlumberger)	

b) Cored Intervals

Diamond Cores Available:

Core #1	3665-3708'	M. Dev. Ls	Rec 42.1'
Core #2	5233-5266'	M. Dev. Dol	Rec. 33.2'
Core #3	5794-5822'	M. Dev. Dol	Rec 24.5'
Core #4	8121-8180'	L. Dev. Ls-Sh	Rec. 59.0'
Core #5	9300-9338'	U. Ord. Ls	Rec 38.4'
Core #6	10840-10900'	Ord. Dol	Rec 60.9'
Core #7	12798-12812'	Ord. Dol	Rec 8.3'

Coring and Testing by Eastland

c) Core Descriptions:

See Appendix A.

d) Sample Descriptions:

See Appendix B.

Section III - Engineering Summary

a) Drill Stem Tests:

DST #1 - Middle Devonian Dol. (4,904' to 5,303') June 20, 1962
Valve open 60 minutes ISI - 30 FSI - 30
Fair air blow remaining constant throughout test.
Recovered 190' drilling mud.
ISIP - 2380 FSIP - 1271 IFP - 83 FFP - 129 IHP - 2578

DST #2 - Middle Devonian Dol. (5,701' to 5822') July 8, 1962
Valve open - 60 minutes ISI - 30 FSI - 30
Fair air blow increasing to strong.
Recovered 3000' sulphurous salt water.
ISIP - 2577 FSIP - 2521 IFP - 450 FFP - 1375 IHP - 2977

DST #3 - Middle Devonian Dol. (6,600' to 6,764') July 26, 1962
Valve open - 60 minutes ISI - 30 FSI - 30
Good air blow increasing to strong.
Recovered 4400' sulphurous water.
ISIP - 2995 FSIP - 2975 IFP - 2660 FFP - 2783 IHP - 3449

DST #4 - Lower Devonian Ls & Sh. (8,200' to 8,251') August 18, 1962
Valve open - 60 minutes ISI - 60 FSI - 30
Weak air blow dying within 30 minutes
Recovered 40' of drilling mud
ISIP - 113 FSIP - 69 IFP - 65 FFP - 69 IHP - 4009

DST #5 - Lower Devonian Ls. & Sh. (8,697 to 8,727) August 30, 1962
Valve open - 60 minutes ISI - 97 FSI - 30
Strong air blow decreasing to medium
Recovered 570' slightly muddy and gassy water cushion.
ISIP - 2567 FSIP - 346 IFP - 289 FFP - 324 IHP - 4308

DST #6 - Ordovician Dolomite (9,480 to 9,913') September 27, 1962
Valve open - 120 minutes ISI - 60 FSI - 120
Weak air blow increasing to fair.
Recovered 2500' water cushion
5540' sulphurous salt water
ISIP - 4182 FSIP - 4125 IFP - 2425 FFP - 3653 IHP - 4802

DST #7 - Upper Ordovician Limestone (9,210' to 9,360') November 26, 1962
Valve open - 60 minutes ISI - 30 FSI - 60
Very weak air blow
Recovered 30' of drilling mud
ISIP - 1780 FSIP - 1393 IFP - 1072 FFP - 1072 IHP - 4686

DST #8 - Ordovician Dol. (12,504' to 12,662') November 28, 1962
Misrun

DST #9 - Ordovician Dol. (13,038' to 13,217') November 30, 1962
Misrun

DST #10 - Ordovician Dol (13,038' to 13,217') December 1, 1962
Misrun

DST # 11 - Ordovician Dol. (13,040' to 13,217') December 3, 1962
Misrun.

N.B. DST charts and pressure reports were forwarded previously.

b) Casing record

Size	Type	Weight	Amount	Set at	Sacks of cement
20"	H-40	94#	136.64'	199.64'	350
13-3/8"	J-55	54#	1951.45'	1971.58'	1080
9-5/8"	J-55 & N-80	36# 40#	5307.65'	5301.0'	1200

c) Bit Record - See Appendix C.

d) Mud report

Gel - Chemical mud used
The following materials were used:

400 sacks Invertin (100#/sx)
1200 Sacks Salt (100#/sx)
4000 sacks Gel (100#/sx)
200 dr. caustic (100#/dr.)
200 dr. Quebracho (50#/dr.)
80 sacks Peltex (50#/sx)
200 sacks Tannathin (50#/sx)
400 sacks Lime (50#/sx)
80 sacks Driscose (50#/sx)
20 sacks Bicarbonate (100#/sx)
500 sacks Silvaseal (40#/sx)
30 sx Nut plug (50#/sx)
5500 sacks Sparton (100#/sx)
20 gallons Quick-Vis (10#/gal)
15 dr. E.P. Lube Oil (500#/dr.)

e) Deviation Record - see Section III Engineering Summary Part C)

f) Abandonment Plugs

Plug # 1 (12,700 - 12,800') 60 sacks could not feel
Plug # 2 (12,700 - 12,800') 100 sacks
Plug # 3 (10,900 - 11,000') 200 sacks
Plug # 4 (9,444 - 9,544') 220 sacks
Plug # 5 (5,250 - 5,350') 240 sacks
Plug # 6 (15 - 65') 25 sacks

g) Lost circulation zones - none

h) Blowouts - none

Section IV - LOGS

Run # 1 - April 28, 1962

Induction Elog	2" = 100'	199 - 1968'
	5" = 100'	199 - 1968'
Microlog - Caliper	2" = 100'	199 - 1968'
	5" = 100'	199 - 1968'
Sonic - Gamma Log	2" = 100'	199 - 1964'
	5" = 100'	199 - 1964'
Temperature Log	2" = 100'	0 - 1965'

Run # 2 - July 13, 1962

Induction Elog	2" = 100'	1972 - 6065'
	5" = 100'	1972 - 6065'
Microlog - Caliper	5" = 100'	1972 - 6062'
Sonic - Gamma Ray	2" = 100'	1972 - 6057'
	5" = 100'	1972 - 6057'
Conductivity Laterolog	2" = 100'	1972 - 6060'
	5" = 100'	1972 - 6060'

Run # 3 - November 20-23, 1963

Induction Elog	2" = 100'	5303 -13201'
	5" = 100'	5303 -13201'
Microlog - Caliper	5" = 100'	5303 -13196'
Sonic - Gamma Ray	2" = 100'	5303 -13175'
	5" = 100'	5303 -13175'
Laterolog	2" = 100'	5304 -13174'

A velocity survey was conducted. A continuous Dipmeter Survey was run from 5300 - 10,600'.

NOTE: All logs were forwarded previously.

Section V - Analysis

- a) Core Analysis - See Appendix D
- b) Water Analysis - See Appendix E
- c) Gas Analysis - See Appendix F

APPENDIX A

CORE DESCRIPTIONS

S.O.B.C. Blackstone Y.T. D-77

(Originally called S.O.B.C. Blackstone Y.T. #1)

65° 46' 10.77" N., 137° 14' 54.78" W.

C O R E

D E S C R I P T I O N S

S.O.B.C. BLACKSTONE Y.T. # 1

65° 46' 10.77" N 137° 14' 54.78" W

Core Description by:

W. Cowan

June 4, 1962

Core # 1 3665' - 3708' Rec. 42.1'

Coring Times in minutes per foot:

17, 13, 15, 16, 14, 12, 12, 12, 13, 15, 12, 13, 12, 11,
12, 11, 13, 11, 10, 10, 10, 10, 10, 10, 13, 12, 12, 16,
21, 20, 18, 18, 19, 20, 31, 36, 34, 30, 33, 32, 66, 70

- 2.4' Limestone recrystallized micro to finely crystalline variably dolomitic and argillaceous and/or bituminous dark gray to dark brown and dark gray appearance on cored surface. Very irregular but rounded contacts - looks like penecontemporaneous breccia. Dark areas are very argillaceous and bituminous. Abundant fossils - colonial corals resembling Favosites, large horn corals, with abundant septae, stromatoporoid bryozoa, few brachiopods with thin shells and other small fragments of fossils - are composed largely of white crystalline dolomite, usually calcareous, and occur in both light and dark areas of rock. Large fossils and some lumps appear eroded. Abundant stylolitic partings. Few small veins of white calcareous dolomite. Very tough, brittle rock. Fossils 30-40%, dark argillaceous "matrix" 10-20%.
- 6.8' Limestone crinoidal similar to above but 10-20% fossils (mostly colonial corals and/or bryozoa up to 4" across), 10-20% dark matrix with corals ossicles. Limestone crinoidal similar to above but very few scattered corals visible. Abundant fine fossil debris visible in dark areas. Noted thin horizontal bed containing small gastropods. Dark "matrix" forms 20-30% of rock.
- 4.6' Limestone crinoidal mottling less apparent and appears mostly dark gray on cored surface but is not very argillaceous. Few large colonial corals and abundant fragments of thin-shelled brachiopod and gastropods.

- 8.8' Limestone crinoidal similar to above. Top 0.3' of interval is colony of Hexagonaria - type coral composed of white calcareous dolomite. Abundant broken and eroded colonies of ? Favosites with tiny corallites. Numerous solitary corals - some of the Cystiphyllum - type, others with abundant septae. (Note - ? Favosites with tiny corallites may be a bryozoa). Some cabbage-type stromatoporoids more numerous downwards - appear eroded and structureless but are coarser crystalline and lighter coloured than surrounding rock. Smaller corals and fossils fragments more numerous downward. Fossils increase from 20 to 70% of rock. Dark areas are less argillaceous than at top of core.
- 7.1' Limestone crinoidal similar to above continuing more fossiliferous downward. Large eroded stromatoporoid. ? Favosites and Cystiphyllum - type corals. Abundant fine fossil debris along with crinoid ossicles in the light areas can be determined only by their crystalinity - they form single crystals with perfect clearance. Fossils 70 - 80% of rock.
- 7.6' Limestone crinoidal recrystallized dolomitic slightly argillaceous and/or bituminous appears dark gray in core but dark brown under "mike". No longer has mottled penecontemporaneous breccia look but only the mottling due to abundant small fossils - corals scattered larger stromatoporoids. This interval cored very slowly partly due to condition of bituminous if not entirely so. Fossils constitute 70-80% of rock. Stylolites are much less common than above. Few tiny veins white calcareous dolomite. Very tough, brittle rock.

S.O.B.C. BLACKSTONE Y.T. # 1

65° 46' 10.77" N 137° 14' 54.78" W

Core Description By:
W. Cowan
June 28, 1962

Core # 2 5233 - 66' Rec. 33.2'

Coring Times in minutes per foot:

18, 36, 20, 12, 24, 14, 11, 15, 18, 20, 22,
18, 13, 15, 14, 16, 18, 24, 11, 11, 12, 14,
15, 11, 22, 21, 21, 30, 18, 15, 15, 15, 15,

Dolomite variably calcareous (white or clear dolomite rhombs in brown calcareous, argillaceous and/or bituminous matrix) microfossil crystalline core looks dark gray but chips under the "mike" appear medium to dark brown abundant crinoid ossicles and other small fossil (mostly brachiopod) debris, numerous brachiopods and a few gastropods all apparently thin-shelled and replaced by white calcite. Faint mottling apparent on cored surface looks like penecontemporaneous breccia. The breccia matrix is darker than the large rounded fragments. The matrix is dolomite whereas the fragments are very calcareous dolomite grading to slightly dolomitic limestone (20%) but it is all very similar. If it is a breccia the matrix may have been dolomitized first. Numerous thin, long mostly vertical fractures infilled with white calcite. Numerous stylolitic partings perpendicular to the core. At 5.8' from top of core Favosites - type colonial coral 4" x 2" in apparent growth position. At 8.4' from bottom possible fragment of stromatoporoid. No porosity seen and no shows.

Note:

This rock is very similar to rock of core # 1, 3665 - 3708'.

Core Description by:
N. Astill
July 7, 1962

Core # 3 5794 - 5822 Rec. 24.5'

Coring times in minutes per foot:

10, 15, 15, 10, 20, 13, 13, 14, 10, 10, 12, 10,
15, 13, 12, 12, 14, 13, 16, 13, 12, 9, 10, 15,
17, 18, 21, 27

5794 - 5811.2'

17.2' Dolomite, variably calcareous dark gray, microxlline to very fine crystalline, becoming fine crystalline in part with scattered fossil fragments - brachipods, crinoids? Abundant stromatoporoids from 5798.5 to 5801'. Stylolite present at 5801.3', 5804.8', 5805 and 5815. Traces of regular porosity at 5805, with linings of pyrobitumen. No other effective porosity or permeability noted. No oil staining noted, but the core frequently has a fetid odour. No bedding is discernible, but the attitude of the stylolites suggests a 1-3° dip. On the surface of the core, the dark gray colour is heavily mottled with large nodular-shaped light brown coloured areas of limestone. On the fresh surface the light areas are microcrystalline, the dark areas are microcrystalline and fine crystalline. At 5811-2' there is an abrupt, irregular, oblique contact with the underlying section.

5811.2 - 5818.5

7.3' Dolomite variably calcareous medium gray, fine to microcrystalline. Surface colour is light grey with scattered, white fossil fragments. At 5814 the dolomite darkens to dark gray with frequent glossy bituminous streaks. There is an abrupt, irregular transition at the base of the darkening back into dolomite, variably calcareous, medium gray, as before, with scattered fossil fragments.

Core Description by:
W. Mudie
August 16, 1962

Core # 4 8121 - 8180 Rec. 59.0'

Coring time in minutes per foot:

8, 10, 10, 12, 10, 10, 10, 12, 10, 9, 10, 9, 11, 10, 9, 8,
9, 13, 10, 10, 10, 9, 9, 10, 12, 9, 11, 12, 12, 12, 15,
12, 14, 10, 14, 14, 12, 13, 13, 15, 13, 13, 16, 17, 15, 18,
19, 16, 15, 14, 15, 18, 17, 21, 25, 30, 22, 21, 34

- 13.3' Limestone dark brownish grey microcrystalline argillaceous and bituminous. Scattered veinlets of white calcite throughout with no apparent pattern. Core has varved appearance to paper thin laminae of dark calcareous shale. Contact between shale and laminae limestone is in most part gradational.
- 0.6' Shale dark gray to black fissile very slightly calcareous.
- 4.0' Limestone as in 13.3' interval above Basal 2.0' of interval becomes more shaly with limestone as almost appearing as breccias in the shale.
- 0.6' Limestone medium grayish brown finely cryptocrystalline - very fossiliferous in large amount of crinoid fragments. Slightly argillaceous and bituminous.
- 3.1' Limestone as in 13.3' interval.
- 3.0' Limestone crinoidal as in 0.6' interval above - more argillaceous.
- 1.2' Shale black fissile slightly calcareous. Brittle.
- 1.6' Limestone dark gray to brownish gray microcrystalline in most part except for individual fossils. Crinoidal and fossiliferous. Fossils are light gray and some are dolomitized. Interval argillaceous and slightly bituminous.

Core # 4 - Continued

- 2.3' Shale dark gray to black fissile and brittle. Slightly calcareous. Occasional fossil.
- 0.9' Limestone fossiliferous as in 1.6' interval above.
- 2.4' Shale black as in 2.3' interval above.
- 3.0' Limestone fossiliferous as above.
- 1.2' Shale black as above.
- 1.1' Limestone fossiliferous as above.
- 1.2' Shale black as above.
- 1.0' Limestone fossiliferous as above.
- 0.6' Shale black as above.
- 3.3' Limestone fossiliferous as above. Upper part of interval has brecciated appearance. Some fine veinlets of calcite.
- 5.7' Shale dark gray mostly black fissile in most part. Calcareous hard and brittle. Some scattered fossils.
- 0.8' Limestone fossiliferous as above.
- 2.0' Shale dark gray, limy with brecciated appearance from floating broken bands, blebs, etc. of limestone dark gray microcrystalline fossiliferous in part.
- 6.1' Shale dark gray to black limy brecciated appearance in part. Some fine calcite veinlets.

N.B. Bedding planes etc. throughout the entire core, have a fairly consistent plane of dip at approximately 20°.

Core Description by:
W. Cowan
September 14, 1962

Core # 5 9300 - 9338 Rec. 38.4'

Coring times in minutes per foot:

21, 36, 27, 33, 30, 25, 31, 27, 30, 29, 30, 30, 30, 34, 25,
36, 35, 35, 37, 34, 38, 28, 38, 35, 33, 39, 27, 38, 38, 38,
39, 40, 39, 40, 44, 45, 48, 50,

- 1.2' Limestone microcrystalline dark gray mostly, slightly argillaceous with streaks of black shale, crinoidal possibly pelletiferous scattered thin brachiopods, very tough and dense. This interval is 40% silicified (black chert) with crinoid ossicles still distinguishable after silicification.
- 13.5' Limestone microcrystalline to cryptocrystalline sub lithographic dark gray brittle almost barren at top but becoming crinoidal with abundant fine shell fragments including spiral gastropods, some small solitary corals all replaced by crystalline calcite penecontemporaneous breccia in part. Few small silicified patches and patches of possible incipient silicification where rock is harder than that surrounding it. Also shaly patches and streaks. Numerous small white calcite veinlets.
- 9' Limestone similar to above but strikingly mottled the irregularly rounded dark lenses roughly parallel to the bedding are areas of silicification. Noted one lens 3" thick crinoidal numerous fractures and veinlets approximately 20% of interval is silicified.
- 6.5' Limestone microcrystalline dark gray, slightly argillaceous massive crinoidal thin-shelled brachiopod fragments solitary corals and ? encrusting stromatoporoids and ? orthocone near base of interval. Small patches dark silicified limestone less than 5% of interval.
- 8.2 Limestone microcrystalline dark gray crinoidal, etc. as above mottled due to 30-40% silicified limestone gastropods and horn corals noted along with two strange calcite-filled structures (near base of core) which may be fossils. Also Favosites and Halysites - type colonial corals and possible encrusting stromatoporoid replaced by white calcite as are other fossils.

Core Description by:
A.D. Graham
October 15, 1962

Diamond Core # 6 10840 - 10900 Rec. 60.9'

Coring times in minutes per foot:

15, 19, 10, 11, 10, 12, 14, 13, 10, 10, 16, 18, 14, 15,
11, 16, 14, 16, 11, 15, 16, 13, 11, 13, 8, 12, 14, 13,
13, 15, 10, 11, 15, 35, 20, 17, 21, 17, 21, 19, 23, 26,
18, 20, 19, 11, 15, 16, 23, 16, 16, 17, 22, 17, 20, 14
13, 11, 16, 12,

0.8' Dolomite, dark gray, argillaceous, calcareous, very fine to fine crystalline, no porosity, core splits easily along shear planes perpendicular to core axis.

0.8 to 22.0' Dolomite, dark gray, occasionally medium gray, variably calcareous, medium to fine crystalline; massive bands up to 2.0' alternating with brecciated bands of angular to sub-angular dark gray dolomite fragments cemented by white medium crystalline dolomite and calcite (some fragments sub-angular to sub-rounded suggesting some replacement of dolomite by white dolomite and calcite); uncomplete infilling by white dolomite and calcite of the brecciated bands has resulted in scattered poor small vuggy porosity totalling 0.6'; very thin sealed (with calcite) vertical to oblique fractures common throughout - one up to $\frac{1}{2}$ " ; core splits easily perpendicular to core axis along shear planes even in massive bands.

22.0 to 24.9' Dolomite, dark gray, argillaceous, calcareous, very fine crystalline, no porosity; core splits easily along shear planes perpendicular to core axis; several oblique fractures with slickensides.

24.9 to 60.9' Dolomite, dark gray; similar in all aspects to rock in interval 0.8' to 22.0'; porosity as above totalling 0.6'; in basal 10.0' several masses of white dolomite and calcite up to 0.3' with only scattered dark gray dolomite fragments.

GENERAL NOTE: Examination of small chips throughout the length of the core, under high magnification, shows in many cases an obscure relief texture of fine fossil fragments (crinoids, oolites, ostracods?, brachiopods) suggesting an original shallow-water type limestone.

Core Description by:
W. Cowan
Nov. 10, 1962

Core # 7 12798 - 12812' Rec. 8.3'

Coring times in minutes per foot:

15, 12, 14, 17, 16, 11, 19, 16, 11, 14, 35, 40, 45, 45,

- 2.0' Dolomite light gray fine to coarse crystalline fairly homogeneous appearance under mike but appears faintly mottled on cored surface good very small vuggy porosity in much of interval, some medium sized vugs (to $\frac{1}{4}$ ") with white drusy linings. Numerous hairline horizontal fractures, in fact core is badly broken up as a result porosity 3-6% and permeability fair for a carbonate no show, brittle rock.
- 0.9' Dolomite fine to coarse crystalline dark gray grading to medium gray but actually finely mottled with white crystalline probably argillaceous small elongate patches of white dolomite suggest fossils horizontal fractures as above core broken into large "poker chips". No porosity seen, trace dark gray chert obviously incipient silicification of the carbonate brittle rock.
- 2.0' Dolomite medium and light gray, fine to coarse crystalline mottled appearance due to mostly complete drusy white carbonate vein filling both horizontal and vertical but still few open vugs. Noted one vug $\frac{3}{4}$ " x $\frac{1}{4}$ " x ? $\frac{1}{2}$ " scattered very small vuggy porosity horizontal fractures, porosity 2-4% permeability poor to fair. No show brittle rock some white dolomite patches resemble brachiopods and corals. Core is badly broken in this interval.
- 2.1' Dolomite very similar to above but mottled on finer scale very small vuggy porosity better developed than above and more numerous medium sized ($\frac{1}{4}$ ") vugs with white dolomite linings, fewer horizontal fractures hence core less broken here, porosity 3-7% permeability fair, brittle rock, no show.
- 1.3' Dolomite very similar to above but irregular patches of dark chert in top and bottom 2" of interval chert badly fractured and veined and is probably more present than indicated in recovered core, numerous vugs up to $\frac{1}{2}$ " , some of which resemble fossil cavity fillings, some fair very small vuggy, porosity between chert bands porosity 3-6% permeability poor to fair no show, brittle rock.

APPENDIX B

SAMPLE DESCRIPTIONS

S.O.B.C. BLACKSTONE Y.T. D-77

(originally called S.O.B.C. Blackstone Y.T. # 1)

65° 46' 10.77" N. , 137° 14' 54.78" W.

S A M P L E

D E S C R I P T I O N S

S.O.B.C. BLACKSTONE YT. #1

65°46'10.77"N 137°14'51.78"W

Sample Description
by: W. Cowan

Note: All depths are from K.B.
Sample interval - 10'

- 0 - 20' No samples.
- 20 - 40' Silt and clay, light grey-brown with lumps of weathered rusty siltstone, patches of limonite and traces of organic material. Several subangular slabs of weathered rusty siltstone were encountered in the silt. Also several zones up to 3' thick of ice granules very much like snow.
- 40 - 60' Gravel or subangular slabs of siltstone, light brown to rusty coloured and pitted by weathering of pyrite crystals variably calcareous with fossil shells of pelecypods occasionally grading to very fine grained sandstone with varicoloured chert grains. Also some white quartzose and quartzitic sandstone, ironstone, dolomite and well rounded glossy black chert pebbles, less than 1/8" in size.
- 60 - 70' Gravel composed of medium to dark grey, argillaceous limestone, probably crinoidal and light brown and light grey crystalline dolomite. Ironstone, siltstone and small glossy black chert pebbles are also common. There are also numerous flat, pellet-like pieces of medium to dark grey bituminous shale, unlike shale below.

Pennsylvanian

- 70 - 90' Shale, light to medium grey, smooth and homogeneous, blocky, quite soft, variably but mostly slightly calcareous. This shale is quite fresh in appearance and represent 99% of the sample and is undoubtedly bedrock. Noted carbonaceous film which may be fish remains and a tiny pyritized tube wity nodes which suggests a pteropod. May be thin laminae of siltstone in the shale.

Note: Drilling with diesel fuel, no circulation via shaker box - samples caught from circulation into cellar and therefore badly contaminated samples.

and sandstone stringers. Also, pyritic films suggesting replacement of fossils.

At 240-50' Shale as described but with abundant white calcite veins and chips composed of crystalline aggregates of calcite.

At 330-31' stringer of quartzose cherty, fine grained, sandstone similar to above. Pyritized tubes resemble tiny pteropods.

At 360' noted bryozoa and probable small pelecypod in argillaceous siltstone.

At 390' pyritized pteropods and traces of ?pelecypod shells.

- 400 - 470' Shale, medium grey to dark grey, some light grey, not bituminous, slightly calcareous, blocky habit and well indurated, pyritic films and pteropods as above, stringers of quartzose and quartzitic, siltstone with variable amounts of argillaceous matrix. Numerous veins of white crystals, calcite. At 450' angular pieces of light grey and light green shale in medium to dark grey shale. At 470' fossil imprint resembles gastropod.
- 470 - 481' Sandstone, light to dark grey, fine to medium grained, fairly well sorted, quartzitic with 80% grey chert grains. Grains are subangular to subrounded, some grains of glauconite some argillaceous matrix as well as silica cement, no porosity or staining.
- 481 - 488' Shale, similar to 400-470'.
- 488 - 494' Sandstone, similar to 470-81' but grading to siltstone.
- 494 - 544' Shale, medium to dark grey, slightly more fissile than shale above and less calcareous, scattered glauconite grains, pyritic films suggest fossil replacement, patches of pyritized? pteropods, shale is well indurated (but not hard) and homogeneous. Occasional thin stringers of siltstone, quartzose and quartzitic, medium brown-grey, variably argillaceous with glauconite grains, slightly calcareous.
- 544 - 655' Shale, similar to above with interbeds of homogeneous, light green-grey, shale non calcareous, slightly waxy appearance, disseminated and nodular, pyrite in both types of shale. At 560-655' interbeds of shale, medium brown, variably dolomitic and slightly silty, glauconitic and bituminous,

hard, brittle.

Abundant pyritized fossil remains, some tubes resemble plant stems.

- 655 - 676' Shale, dark grey, brownish cast under microscope, slightly calcareous or dolomitic, variably bituminous and glauconitic (?glauconite in quite large irregular patches rather than fine, rounded grains seen in sandstone). Abundant pyritized? plant stems. Stringers of sandstone, very fine grained, quartzose but with abundant light coloured chert grains, subangular to subrounded.
- 676 - 810' Shale, dark grey to black, very bituminous, slightly glauconitic as above, waxy lustre, soft, smooth, large fossil imprints, suggest fish remains as do tiny lustrous black conodonts which look like spines or teeth pyritic films and tubes. Interbeds of much harder shale, dolomitic, medium brown. Slight gas kicks.
- 810 - 920' Shale, dark grey to black, very bituminous, glauconitic, very similar to above interval but this lacks the lustre and smoothness and is silty and harder. Stringers of siltstone, medium grey and brown, calcareous, argillaceous, varying to sandstone, very fine to fine grained, calcareous, white to light grey, quartzose, subangular grains and varying to limestone, light to medium brown, argillaceous, variably silty and sandy with fossil imprints and fillings of calcite suggest thin shelled brachiopods or pelecypods calcite veins.
At 820-40' imprints and thin shells suggest oysters.
At 910-20' abundant patches and tubes of pyrite on bedding planes resemble plant stems.
- 920 - 940' Shale, dark grey to black, bituminous, glauconitic and silty as above with stringers of siltstone etc. Also probable thin interbeds of shale, light to medium grey not bituminous or silty or calcareous, smooth and a little harder than bituminous shale. Both types of shale have pyritized fossil forms.
- 940 - 970' Shale, bituminous as above but stringers with calcareous white specks. Stringers of siltstone and sandstone as described at 810-920'.
Note: Shale becoming more silty downward.
- 970 - 1053' Siltstone, medium to light brown, variably calcareous but usually not much cement, very quartzose few stringers or lenses of siltstone with silica cement, looks like chert

with conchoidal fracture. This varies to medium to dark brown, silty, silicified shale in part, all very hard. Approaches very fine grained sandstone in part too. Trace black slickenside surfaces and calcite veins.

- 1053 - 1090' Shale, medium to dark brown-grey to black, slightly bituminous and calcareous, variably silty, homogeneous, dull appearance, well indurated but not too hard, much softer than silty, silicified shale above. Traces fossil remains - tubes filled with white calcite and pyrite (1080-1090').
- 1090 - 1130' Siltstone, medium to dark grey-brown, variably calcareous and argillaceous, harder than interval 1053-90' but softer than 970-1053'. Grades to silty shale and very fine grained, calcareous sandstone.
- 1130 - 1183' Shale, medium to dark brown-grey, slightly calcareous, silty and bituminous, well indurated but not too hard, similar to 1053-90'. Stringers of siltstone as above. At 1170-83' thin white calcite veins and crystal aggregates suggesting voids.
- 1183 - 1201' Siltstone, medium to dark grey-brown with lighter-coloured chalky patches which are probably results of bit damage variably argillaceous (and generally quite so) and usually quite calcareous, fragments of thin shelled mollusks and fossil debris, thin white calcite veins, some tubular fossil remains seem to have and outer wall of crystalline quartz and a central cavity filled with white calcite. Some stringers contain abundant medium grains of grey chert and clear quartz. Much of the fossil debris is tiny white tubes of calcite or quartz.
- 1201 - 1214' Shale, dark grey to black, very bituminous, non calcareous, quite soft and lustrous, slightly silty gas kicks.
- 1214 - 1250' Siltstone, medium to dark brown-grey, variably calcareous and argillaceous but usually quite argillaceous grading to silty shale. Also stringers of sandstone, very fine to fine grained quartz and chert grains, subangular to subrounded, calcareous, light brown to white in color. At 1230-40' stringers of siltstone and sandstone have silica cement or are silicified - look like brown chert with conch fracture but are granular.
- 1250 - 1271' Shale, bituminous, dark brown-grey to black, slightly calcareous with white veins of calcite, variably silty,

fairly soft but harder than some bituminous shale intervals, above sometimes grades to very calcareous, medium brown shale.

- 1271 - 1286' Siltstone, dark to medium brown grey, quite argillaceous and grading to silty shale, variably calcareous with veins of white calcite.
- 1286- 1352' Shale, dark grey to black, very bituminous, silty, but quite soft, pyritized fossil remains, lustrous appearance gas kicks veins, white calcite.
At 1330-52' very soft, bituminous shale.
- 1352 - 1365' Siltstone, light to medium grey-brown, quite calcareous, only slightly argillaceous, quartzose, subangular to subrounded, 10% cement and matrix fragments of thin shelled mollusks.
- 1365 - 1369' Shale, dark grey to black, slightly calcareous, quite bituminous, variably silty, grading to argillaceous siltstone.
- 1369 - 1383' Siltstone, light to dark grey and brown, variably argillaceous and calcareous as described above, abundant tiny white fossil fragments (shells) and shale, dark grey to black, variably silty and bituminous as above.
- 1383 - 1386' Shale, black, bituminous and silty as above with thin beds or lenses of silicified siltstone, medium to dark brown conchoidal fracture, looks like chert, very brittle and hard.
- 1386 - 1390' Shale, dark grey to black, bituminous, silty as above, quite soft.
- 1390 - 1400' Siltstone, light to medium grey and brown, slightly argillaceous, apparently quite calcareous but only 10% cement-matrix, some calcareous, fossil fragments, grains are subangular to subrounded, fairly well sorted but some fine sand size grains, very quartzose but some brown chert grains.
- 1400 - 1410' Shale, dark grey to black, variably bituminous and silty, slightly calcareous, partly silicified giving variable hardness.

Described by: R. Carlyon

- 1410 - 1420' Siltstone, calcareous, argillaceous, medium grey brown, very fine quartz, has been silicified and slightly fused, very hard and dense.
40% shale, bituminous, siliceous, black, relatively hard, poorly fissile.
15% chert, medium-dark grey brown, light in part, very hard and dense.
- 1420 - 1430' Shale, siliceous, slightly bituminous, dark grey-black, hard and dense.
25% siltstone - as at 1410'.
- ?Pennsylvanian Limestone 1430'
- 1430 - 1440' Chert, medium to dark grey, light in part, extremely hard and dense.
30% limestone, argillaceous, siliceous in part, very fine crystalline, dense and tight, shows much chalky bit damage.
- 1440 - 1450' Siltstone, calcareous, argillaceous, medium grey-brown, has been silicified, slightly fused, very hard and dense.
20% chert, light-medium grey brown.
- 1450 - 1460' Limestone, siliceous, slightly argillaceous in part, light grey brown, very fine crystalline, dense and tight.
20% chert, light-medium grey brown, very dense.
5% shale, siliceous, slightly bituminous, black, relatively hard and dense.
- 1460 - 1470' Chert, medium-dark grey brown, light in part, very dense and hard.
25% limestone, siliceous as at 1450'.
- 1470 - 1480' Shale, siliceous, bituminous, black, poorly fissile, brittle, relatively hard.
15% chert, light-medium dark grey brown.
- 1480 - 1500' Shale, very bituminous, slightly siliceous, fissile, brittle, relatively hard.
Trace chert and siltstone as at 1460' and 1440' respectively.
1480-90' 5% chert and 15% siltstone.
- 1500 - 1530' Shale, siliceous, calcareous, bituminous, black, very hard and dense, soft and fissil in part.

1500-10' 10-15% limestone, siliceous, argillaceous, light-medium grey-brown, very dense and tight, very finely crystalline, trace chert and siliceous silt.
1510-30' 10-15% chert, medium grey-brown, very hard and dense, trace siliceous silt and limestone, trace fossil.
1520-30' Shale becoming non calcareous.

Mississippian Shale 1530'

1530 - 1800' Shale, very bituminous, black, medium soft, fissile.
1530-50' Trace pyrite.
1530-60' 5-10% siltstone, highly silicified, almost a chert, medium grey brown, very hard, dense and tight.
1560-80' Trace pyrite, chert and siltstone.
1580-90' Trace pyrite.
1590-1610' Trace pyrite and chert.
1610-1620' Trace pyrite and siltstone.
1620-1630' 40% Shale, contains 40-50% finely disseminated pyrite, slightly siliceous, could be silty, trace chert.
1630-1640' 10% shale with pyrite as at 1620'.
Trace siltstone, siliceous.
1640-1670' 10-15% Chert and siltstone, silicified, argillaceous, recirculated? surging tanks, trace pyrite.
1670-1740' Trace pyrite, chert and siltstone to 5%, argillaceous, silicified, light-medium grey-brown, very hard and dense, very minor traces limestone, slightly argillaceous, siliceous (silty?), light-medium grey, very fine crystalline, very dense and tight.
1740-1750' 5-7% siltstone as at 1700'.
Trace pyrite and siliceous limestone.
Trace white crystalline, anhydrite.
1750-1780' 5-7% siltstone as at 1200'.
Trace pyrite, trace white crystalline, anhydrite.
1780-1790' Shale, slightly siliceous, relatively hard, poor fissile.
1790-1800' Trace pyrite and siltstone.

1800 Shale, very bituminous, black, medium to soft, fissile, brittle.
1800-10 & 25% siltstone, slightly argillaceous, slightly
1820-30 calcareous, strongly silicified, very hard and dense, light-medium grey-brown, very poorly sorted in part with traces dark chert pebbles, rounded to 2 mm.
1810-20 15% siltstone, argillaceous, very slightly calcareous in part, partly silicified, very dirty look, very dense and tight, medium grey-brown.

1820-40' Trace shale, medium-dark brown, siliceous, hard and dense, non fissile.
1840-50' Trace silt and fine sandstone, quartzose, dirty poorly sorted, dense and tight, trace pyrite.
1850-60' 5% siltstone, quartzose, slightly silicified, argillaceous, very dense and tight.
Trace pyrite.
1860-70' 25% shale, dark brown-black, siliceous, slightly silty in part, hard and very dense.
Trace pyrite, chert, silt and sandstone.
1870-80' 5-10% sandstone, quartzose, silicified, poorly sorted, argillaceous, slightly kaolinitic (?), medium brown, very dense and tight.
Trace pyrite, limestone and chert.
1880-90' 5-10% sandstone, quartzose, silicified, light grey, very clean, very dense and tight.
Trace pyrite and silt.
1890-1900' 5% siltstone, argillaceous, dirty look, very dense and tight.
25% Shale, dark brown grey, siliceous, slightly silty, hard and compact.

1900 - 1930'

Shale, very bituminous, slightly siliceous, poor fissile, relatively hard, black.
1900-20' Trace shale, slightly silty, hard, brown-grey.
5% siltstone, argillaceous, dirty, hard, dense and tight.
Trace pyrite.
1920-30' 25% Siltstone to very fine sandstone, light grey very clean, strongly silicified, very dense, tight and hard.
Trace pyrite.

1930 - 1980'

Shale, very bituminous, fissile, medium soft, black.
1930-40' 5% siltstone, very argillaceous and dirty, tight and dense. Trace pyrite.
1940-50' Trace pyrite, dirty silt, limestone and anhydrite.
1950-60' Trace pyrite.
1960-70' Trace pyrite, very fine sandstone (tight) and anhydrite.
1970-80' Trace dirty silt.

Description by: W. Cowan

1980 - 2109'

Shale, dark grey, quite bituminous but less so than intervals above, very soft, smooth and glossy lustre, pods and streaks of finely disseminated pyrite, occasional silty stringer with ? plant remains, also scattered angular, chert and quartz grains of up to medium sand size, grading to stringers of sandstone. Noted piece of pyritized? wood. Sandstone stringers are poorly sorted with 10% shale matrix and very slightly calcareous. Some of the shale has brownish tint and is calcareous.

- At 2025, 2045 and 2055' stringers of sandstone, white, quartzose and quartzitic, fine grained, angular, fairly well sorted, very slightly calcareous.
At 2030-40' trace milky white, anhydrite veins, slickensided.
At 2080-90' Stringers of very coarse, angular, dark grey chert, grain sandstone with grains of pyrite.
At 2100' stringer of sandstone, white, quartzose and quartzitic, very fine to fine grained, trace drusy vein or vug, well terminated, small clear quartz crystals.
- 2109 - 2120' Sandstone, light brown, quartzose, quartzitic, very fine to fine grained, angular, fairly well sorted, trace intergranular porosity in some chips and a few with 10-15% porosity, lightly oil stained but no fluorescence with chloroform, no appreciable gas kick.
- 2120 - 2190' Shale, bituminous and soft as above.
At 2140' stringers of sandy shale, quartz grains, vary from rounded to angular and are fine grained, some chert grains are usually larger.
At 2155 and 2168' Stringers, sandstone, very fine to medium grained; medium grey, argillaceous to quartzitic, quartz and chert grains.
At 2190' trace milky white anhydrite veins.
- 2190 - 2210' Shale, bituminous and soft, as above, but numerous sandy stringers, occasionally grading to sandstone as described above, abundant disseminated pyrite in shale and sandstone.
- 2210 - 2260' Shale, bituminous and soft as above with few stringers of siltstone, medium brown, argillaceous, numerous lumps of massive pyrite, veins of anhydrite.
- 2260 - 2270' Shale, bituminous and soft, as above with numerous stringers of sandy shale grading to sandstone, very fine to fine grained, as described above, abundant lumps of massive pyrite, surrounded by black, bituminous shale.
- 2270 - 2330' Shale, dark grey, bituminous, soft, smooth with lumps of massive pyrite and patches, disseminated pyrite, veins of milky, white anhydrite.
At 2315 and 2320' stringers of sandstone, medium grey, fine grained, argillaceous.
- 2330 - 2350' Sandstone, medium to dark grey, argillaceous to quartzitic, quartz and chert grains, very fine to medium grained, fairly well sorted, mostly angular, not much matrix or cement, disseminated, pyrite, may have shale interbeds, not too tough.
- 2350 - 2374' Shale, bituminous and soft, as above, with anhydrite veins and lumps of pyrite, some resembling plant stems. Not so soft, as above.

- 2374 - 2377' Sandstone, medium brown, very fine to fine grained, fairly well sorted quartzose and quartzitic, some argillaceous trace of porosity in better sand, very lightly oil stained.
- 2377 - 2410' Shale, quite bituminous and soft as above with stringers of medium to dark grey siltstone, lumps of massive pyrite and sand grains with pyrite cement.
- 2410 - 2460' Shale, much less bituminous and soft than above, trace silty stringers and stringers, very fine grained, sandstone quartzose and quartzitic, medium grey, some very argillaceous with abundant, usually coarser, grey chert grains. At 2470-80' numerous chips of dark brown, bituminous, shale breccia with matrix of quartz and pyrite.
- 2460 - 2690' Shale as at 2410-60' but no sandstone stringers or breccia, abundant chips, massive, pyrite present. At 2520-2690' stringers of microcrystalline, resinous, brown, fairly soft, mineral which effervesces slightly and is probably siderite, sometimes with quartz grains. At 2540-2550' stringers variably argillaceous, fine grained sandstone and veins of white quartz. At 2580-2590' noted circular pyritic, cross sections of cylinders in shale, probably plant stems. At 2590-2610' crystalline? siderite, more abundant. Siderite nodules may be causing the rough drilling in this interval. Sometimes appears to be a sideritic siltstone, very hard and brittle. At 2630-2640' noted abundant tiny cone shaped or cylindrical fossils replaced by pyrite, same as seen, much higher in section and called pteropods but may be plant remains. At 2670-2680' interbeds of medium grey, smooth textured, non calcareous shale.

Fort Creek Shale 2690'

- 2690 - 2710' Shale, dark grey, slightly bituminous, tough, because of coarsely disseminated pyrite, giving striking mottled appearance, chips contain up to 50% pyrite but mostly 10-20%, also massive, pyrite. At 2710' noted cross section, pyritized wood stem.
- 2710 - 2720' Shale, dark grey but slightly darker than above and very bituminous, otherwise similarly pyritic, some of it is pyritized wood, stringers or nodules of massive crystalline siderite and sideritic shales

- 2720 - 2740' Shale, dark grey, very bituminous as above but very little pyrite, stringers of siderite and sideritic shale and trace of coal.
- 2740 - 2750' Siderite and sideritic shale, resinous, dark brown-grey, microcrystalline with some fine crystals showing perfect cleavage, slightly calcareous, very tough and does not drill as fast as shale stringers of bituminous shale as above.
- 2750 - 2760' Shale, very bituminous as above with stringers or nodules of sideritic shales.
- 2760 - 2850' Shale, black, very bituminous, smooth glossy surface, not as soft as some bituminous shales above. Trace white calcareous specks and stringer, light grey quartzose siltstone. Traces black chert-like? silicified shale, probably small lenses, some with micro breccia structure. Still traces of crystalline siderite in shale, exhibiting perfect cleavage. Shale maybe quite sideritic? This bituminous shale is more fissile and brittle than bituminous shales, above, becoming harder downward. At 2820' traces milky white anhydrite veins. Traces plant remains. At 2830-2850' traces light grey and brown? sideritic siltstone and very fine grained quartzose sandstone. Trace coal. Numerous pieces, massive pyrite, often with a wood grain, slickensides in shale. At 2850-2860' few very coarse, rounded, grey chert grains, probably forming a stringer in shale. High gas kicks through entire interval to 2850' where there is abrupt decrease.
- 2850 - 2980' Shale, black, similar to above, quite hard, seems to scratch the pick, abrupt decrease in gas analysis, probably because shale is less bituminous and more sideritic, massive and disseminated pyrite, few stringers, silt and nodules silicified shale, numerous chips, microcrystalline, dolomite, much driller shale than above. At 2960-2980' shale similar to other but much lighter brown and even grey streak forming interbeds, more dark grey than black.
- 2980 - 3045' Shale, dark grey, homogeneous, probably slightly bituminous, and/or sideritic, low gas readings, seems softer than black sideritic shale above has light brown and grey streak has thin silty stringers and occasional stringers of fine quartz grains, trace finely disseminated pyrite, drills

slower than shale above.

At 3000-10' abundant massive pyrite, with apparent wood grains and some disseminated in shale, forming streaks. Also noted partial fossil tube of pyrite with core of white crystalline calcite - stems?

At 3010-45' some shale stringers are very bituminous.

3045 - 3170'

Shale, black, quite bituminous and/or sideritic as above. 2980' has medium brown streak, smooth and glossy lustre quite soft, drills faster than interval immediately above but does not look much different, low gas readings. At 3060-70' numerous pieces of massive, pyrite, mostly with wood grain.

At 3080-3100' stringers of lighter coloured shale with light grey and brown streak as above.

Also stringers of siltstone with glassy, clear quartz grains, very angular.

At 3110-20' several chips of wood grain replaced by white to light brown, mineral with perfect cleavage and very slight effervescence - dolomite.

At 3130-40' trace quartzose, siltstone stringers.

At 3150-70' interbeds of dark grey shale with light grey and light brown streaks, less bituminous. Also noted chip with small patches of crystalline dolomite. Also slickensides with trace milky anhydrite veining.

3170 - 3310'

Shale, dark grey, smooth but granular, sort of texture, but quite soft and apparently not silty, light grey to light brown streak much less bituminous than above, drills slower, numerous chips, massive pyrite and noted one chip of very fine grained sandstone with disseminated pyrite. At 3200-3310' much of shale has brown tint and is granular looking but not silty generally. It does effervescence very slightly though and so the shale may be sideritic. Noted small spheres of pyrite in shale. Drills faster than interval 3170-3200'.

At 3230-40' few stringers of glassy quartz grains in shale, varying from silt to fine sand sizes.

At 3240-50' stringers of medium to dark brown-grey, argillaceous, siltstone. Trace clear quartz veins.

At 3250-70' Numerous chips with abundant fine crystals or crystalline masses of soft, clear, mineral with perfect cleavage and slightly effervescence - dolomite.

At 3280-3310' numerous chips of massive pyrite and small pyrite spheres with structure suggesting plant remains. Slickensides and milky anhydrite.

These softer, lighter grey streaked shales with the granular to crystalline look may be anhydritic.

- 3310 - 3335' Shale, similar to above (70%) and interbeds of siltstone, dark grey or brown-grey, trace to abundant white cement which effervesces slightly and may be dolomite and is probably same mineral that forms veins in shale where it appears very soft and with good cleavage, siltstone is variably argillaceous and bituminous with streaks of finely disseminated pyrite which occasionally suggests fossil wood 90% of siltstone is angular quartz, silt. Trace milky white anhydrite veins, also pieces massive pyrite. Quartz grains tend to become coarser downward.
- 3335 - 3363' Siltstone, grading to fine grained sandstone, poorly sorted, 80% quartz grains but scatter, coarse, rounded grey chert grains in the sandstone, generally abundant, argillaceous and/or bituminous matrix, slight effervescence, disseminated pyrite, mostly dark brown-grey and tough. Veins of probable white crystalline dolomite. Numerous chips of massive pyrite with wood grain. Veins of milky, white granular anhydrite.
- 3363 - 3377' Shale, medium to dark brown-grey, glossy lustre, slight effervescence (probably sideritic) quite tough and silty looking but much of it is not, drills faster than siltstone above, may be stringers of siltstone and scattered quartz grains in shale, light grey or brown streak. Trace medium brown ?silicified shale resembling chert. Noted rusty? staining on some chips which resemble "fault gouge".
- 3377 - 3380' Siltstone grading to fine grained sandstone, very similar to interval 3335-63'.
- 3380 - 3390' Shale, medium to dark grey, homogeneous, fine textured, light grey streak, quite soft, does not effervesce as shale above. probable stringers of siltstone and sandstone as above.
- 3390 - 3410' Siltstone, dark to medium grey, quartzose and quartzitic to argillaceous, pyritic, very hard, some larger grains of grey chert, otherwise fairly well sorted, does not effervesce. Stringers of shale as above. Veins of white crystalline dolomite and glassy quartz. Numerous chips of massive pyrite.
- 3410 - 3436' Sandstone, medium grey, mostly fine to medium grained but varying to silt and coarse grained (usually rounded grey chert), quartzose and quartzitic to argillaceous, breaks through grains, slightly effervescence. Some stringers are 80% chert grains, which tend to be more rounded than the quartz grains. Veins of white dolomite in sandstone.

Finely disseminated pyrite in sandstone and chips of massive pyrite.
Stringers of shale as above.

- 3436 - 3455' Shale, dark grey, homogeneous, glossy lustre, light grey, streak, quite soft and drills faster than sand above. Traces medium brown-grey? sideritic, siltstone, very hard, possibly as nodules in shale. Numerous chips of massive pyrite stringers of dark grey siltstone, quite argillaceous.
- 3455 - 3460' Siltstone with scattered grains and stringers of fine to medium grains of quartz and grey chert, medium to dark brown-grey, argillaceous, very slight effervescence, may indicate siderite patches and cylinders of pyrite, suggest plant remains.
Stringers shale as above 10%.
- 3460 - 3480' Shale, dark grey, streak, varies from brown to grey, variably bituminous, quite soft, 80%.
Stringers of siltstone as above, chips massive pyrite.
- 3480 - 3500' Shale as above 80%.
Stringers of siltstone as above, grading to fine to medium grained, sandstone medium to dark brown-grey, argillaceous to quartzitic, quartz and chert grains mostly angular, poorly sorted, pyrite sphere have structure suggesting plant remains.
Traces white anhydrite and white dolomite veins (separate).
- 3500 - 3552' Shale, dark grey, homogeneous, mostly light grey streak, some brown and bituminous, no effervescence, silty streaks, 90%.
Stringers of siltstone as above.
Pyritic sphere as above, chips of massive pyrite.
Trace white anhydrite veins.
- 3552 - 3572' Shale, black, very bituminous and soft, glossy lustre, finely disseminated, pyrite noted, thin pyritic film which suggests a fossil leaf - this chip was removed to separate container. Traces white anhydrite veins and veins glassy quartz. Noted chip containing black chert (or silicified shale?) and bituminous shale in irregular contact - chert contained small patches of quartz crystals noted, another chip of probably brecciated black chert fragments in crystalline quartz matrix.
- 3572 - 3610' Shale, black, bituminous, not silty but possibly sideritic, harder, duller and often more streaky texture than above. Trace apparently variably silicified shale and black "chert" which is probably silicified shale or siltstone. Stringers of quartzose siltstone. Numerous chips massive pyrite. Veins of glassy quartz and white anhydrite (separate).

Middle Devonian Limestone 3610'

- 3610 - 3665' Limestone, recrystallized, variably dolomitic, dark grey and dark brown, not noticeably crystalline but probably because of chalky bit damage, variably argillaceous and/or bituminous but more so at top of interval. Micro to fine crystalline, fossiliferous, few small white dolomite veins, chips have mottled appearance.
At 3620-30' small thin shelled pelecypod, large crinoid ossicles replaced by calcareous dolomite crystal showing perfect cleavage.
At 3630-40' becoming more noticeably crystalline, crinoidal limestone. Still much bit damage. Abundant fine fossil fragments, possibly mostly crinoidal, though some are quite shapeless.
At 3640-65' probably poorly preserved, colonial corals and ?bryozoa. Sample becoming lighter coloured, less argillaceous and probably more fossiliferous.
- 3665 - 3708 Limestone, similar to above. Remaining samples available. See core description (Core #1).
- 3708 - 3730' Limestone, recrystallized, variably dolomitic, dark grey and light brown to white, mottled, dolomitized fossils, variably argillaceous and/or bituminous, crinoidal abundant corals but difficult to identify in chalky limestone chips. Few small veins, white calcareous, dolomite. Some chips are very calcareous and rock may grade to pure limestone.
- 3730 - 3854' Limestone, recrystallized, crinoidal, fossiliferous, micro to fine crystalline, variably dolomitic and similar to limestone above, variably argillaceous and/or bituminous, fine grains, are either pellets or rounded rock fragments, light to dark brown textures are obscure since recrystallization has claimed the matrix or cement and the fossils. Probably abundant corals and brachs although indistinguishable in chalky chips, shaly streaks.
At 3750-60' trace pyrobitumen with dolomite crystals and clear quartz crystals. Veins of white calcareous dolomite.
At 3810-20 noted ?bryozoa.

Note: Definite drilling break here which may coincide with base of cliff forming unit as exposed in Ogilvie Mtn. front. The unite below drills faster and is recessive in outcrop.

- 3854 - 3967' Limestone, recrystallized, variably dolomitic, light to dark brown, some grey, probably fewer large corals and brachs, hence less mottled appearance but abundant small fossils and fossil debris (bioclastic), crinoidal probably pelletiferous, although outlines of grains are obscure due to recrystallization, micro to fine crystalline with white calcareous dolomite, replacing fossils and matrix or cement. Veins of white calcareous dolomite. Faster penetration may be due to more homogeneous nature of rock, variably argillaceous and/or bituminous, much bit damage so that it is impossible to see textures without etching. Possible pyrobitumen in white dolomite veins. May be more argillaceous than unit above. Abundant black bituminous, material or pyrobitumen, finely disseminated throughout, much of rock associated with clear crystalline dolomite replacing corals etc.
- 3967 - 4038' Limestone, recrystallized, variably dolomitic (some very slightly), mostly microcrystalline and fine grained, probably pelletiferous and crinoidal. Few large corals. Matrix or cement and fossils have been dolomitized. Variably argillaceous and/or bituminous. Small but good gas kick at 3971-72', probably from fracture since large well terminated clear calcareous dolomite crystals are numerous. Some lithographic limestone, light brown with patches of white calcareous dolomite crystals, becoming more abundant downward.
- 4038 - 4084' Limestone, variably recrystallized and dolomitized, similar to above, light to dark brown pelletiferous, crinoidal and lithographic types, possibly less argillaceous and/or bituminous and drills slower than above. Probably few corals and brachs.
- 4084 - 4100' Limestone, similar to above but largely lithographic, drilled faster than above lithographic and pelletoidal types. This interval drilled at 6-8 min/ft. (but may not reflect any lithologic property since base of interval coincides with a connection).
- 4100 - 4170' Limestone, recrystallized, dolomitic, mottled, medium and dark brown and white, micro to fine crystalline, pelletoidal crinoidal, abundant fossil debris and/or bituminous, numerous corals and brachs. (note no lithographic limestone in this interval, so there is a change in lithology which may explain drilling rates).
- 4170 - 4190' Limestone, as above but some interbeds of light to dark brown, lithographic type with very few fossils, composes 30' of interval

- 4190 - 4310' Limestone, light to dark brown, partially recrystallized, mainly the fossil debris, cryptocrystalline, lithographic, very slightly argillaceous and/or bituminous, some interbeds of crinoidal pellet limestone, tiny white dolomite veins, trace pyrite crystals, very few fossils and very little fossil debris.
This type of lithographic limestone is noticeably less damaged by the bit.
Also interbeds of fossiliferous (much of it fine fossil debris) limestone. These chips generally show chalky bit damage.
Forms up to 25% of interval.
At 4310' brachiopod shell.
At 4226' gas kick, probably from a fracture or associated with stringer of quartz grains.
- 4310 - 4370' Limestone, some partially recrystallized and dolomitic, micro to fine crystalline, lumpy, pelletoidal, crinoidal, fossiliferous, some cryptocrystalline, crinoidal, lithographic, all light to dark brown, scattered large fossils replaced by white dolomite. The lithographic type is more abundant composing 60-70% of interval.
At 4367' gas kick, probably from fractures with ?pyrobitumen and/or tiny vugs with ?pyrobitumen (these appear in sample 4370-80').
- 4370- 4400' Limestone, similar to above interval but less of the lithographic type. Other is recrystallized, very crinoidal and less pelletoidal, abundant fossil debris but only few large fossils, dolomitic and forms up to 50% of interval.
The gas kick at 4367 may mark top of this rock unit.
At 4390-4400' noted large fragment of thin shelled brach with reticulate ornamentation. Fragments of ?colonial corals
Note: some chips of lithographic limestone are very soft and chalky due to bit damage.
- 4400 - 4430' Limestone, similar to above interval but 60-70% lithographic type, mostly dark brown.
- 4430 - 4450' Limestone, similar to above but two types about 50-50 or favouring the recrystallized, crinoidal fossiliferous type. Both types have crinoid ossicles but being much more abundant in the coarser rock.
- 4450 - 4500' Limestone, recrystallized, variably dolomitic, light to dark brown, micro to fine crystalline, very crinoidal, abundant fossil debris of shells, mostly some large corals and brachs. Some lithographic limestone as above up to 20% white dolomite veins in both.

- 4500 - 4530' Limestone, similar to above interval, all crinoidal, lithographic type up to 40% of interval, few large brach fragments - shells are apparently thin. Interval slightly argillaceous and/or bituminous.
- 4530 - 4570' Limestone, all light to dark brown, crinoidal, some recrystallized dolomitic fossils and fossil debris, replaced by white calcareous dolomite, micro to fine crystalline 80%, some lithographic with only scattered crinoid ossicles and possible pellets.
Interval slightly argillaceous and/or bituminous.
- 4570 - 4580' Limestone, similar to interval above but more lithographic type.
Trace of dolomite 75', microcrystalline, white, dolomite crystals in dark brown to light brown, argillaceous and/or bituminous, calcareous matrix, no original textures, friable.
- 4580 - 4610' Limestone, light to dark brown, cryptocrystalline, lithographic, scattered dolomitized, fossil fragments and crinoid ossicles, also fossiliferous, pelletoidal, lump, microcrystalline, limestone.
Trace dolomite as above, trace veins and/or vugs filled with to clear carbonate crystals and pyrobitumen.
- 4610 - 4660' Limestone, mostly lithographic as interval above.
No dolomite noted.
- 4660 - 4680' Limestone, mostly lithographic, some fossiliferous and partly dolomitized (dolomitic limestone) up to 30% microcrystalline, white, dolomite rhombs.
Much of apparently lithographic limestone is dark brown and probably pelletoidal as seen on etched surfaces. Some with abundant fossil debris, recrystallized.
- 4680 - 4720' Limestone, similar to lithographic type above but generally abundant fossil debris in the fine lime mud matrix, crinoidal, numerous brach and coral fragments, fossil fragment, replaced by clear crystalline, calcareous dolomite, some pellets and lumps, varies from micro to fine crystalline, mostly medium to dark brown, gas kicks.
- 4720 - 4745' Limestone, mostly medium to dark brown, lithographic, few scattered dolomitic fossil fragments as above, also fossiliferous limestone 20%.

Middle Devonian Dolomite 4745'

- 4745 - 4810' Dolomite, dark to light brown and light grey, micro-crystalline, variably calcareous, matrix, no fossils, apparent, white dolomite veins. Also traces of well formed, clear quartz crystals indicate open vugs. Interbeds limestone, mostly dark brown, similar to lithographic type, above but variably dolomitic and probably actually grades to the microcrystalline dolomite described in this interval. Trace disseminated, very fine pyrite crystals. Trace tiny quartz crystals.
- 4810 - 4820' Limestone, mostly medium to dark brown, lithographic, cryptocrystalline, scattered crinoid ossicles and ?shell fragments, brittle, variably argillaceous and/or bituminous, numerous tiny clear quartz crystals and tiny pyrite crystals.
- 4820 - 4850' Limestone (70%) and dolomite as above, interbedded, some of the limestone chips are soft, white and crumbly, probably due to bit damage.
- 4850 - 4922' Dolomite, microcrystalline, uniform texture, light to dark brown, light grey, 20% white dolomite rhombs in argillaceous and/or bituminous, calcareous matrix, no fossils, apparent dense limestone lithographic as above 10%. Trace tiny quartz and pyrite crystals as above. Note: Dolomite apparently suffers less bit damage than limestone. At 4890-4922' abundant to numerous veins of white carbonate (calcareous dolomite) with tiny quartz crystals, chips are white, crumbly and show extreme bit damage. The light grey dolomite contains very little argillaceous material and shows good crystallinity. Becoming more abundant below 4900'.
- 4922 - 4928' Note: Fast drilling break. Dolomite, light grey to light brown, some dark brown, microcrystalline, calcareous, small vuggy coralline (born corals and colonial corals), porosity, 3-6% in 10-15% of chips in sample 4920-30'. Noted large septate horn coral with pyrobitumen in small vugs. No gas kick or show with chloroethene, clear dolomite and quartz crystals in vugs.
- 4928 - 4950' Dolomite, light to dark brown and light grey, slightly calcareous, microcrystalline, dense, argillaceous and/or bituminous, traces, very poor porosity in very small vugs at top of this interval.

- 4950 - 5004' Dolomite, mostly dark and medium brown, some light brown and light grey, cryptocrystalline to microcrystalline, dense, argillaceous and/or bituminous, calcareous. At 4960' trace brachiopodal lithographic limestone. Contains quartz, silt or tiny crystals or both. At 4975-85' trace lithographic limestone, light brown, light grey. Abundant white carbonate veins in most samples, very soft, chalky, chips.
- 5004 - 5013' Dolomite, very similar to above, mostly medium to dark brown, microcrystalline, small vuggy porosity in streaks probably parallel to bedding up to 6%, veins white carbonate, may not be porosity throughout entire interval but interval does represent a fast drilling break. Interval 5009-12' drilled at 10 min./ft. as against 20-25 min./ft. for non porous dolomite. No shows.
- 5013 - 5055' Dolomite, mostly cryptocrystalline and some microcrystalline, light to dark brown and light grey, dense, slightly argillaceous, some looks like lithographic limestone, veins of white carbonate, tiny patches of ?pyrobitumen in light and medium grey-brown, cryptocrystalline dolomite. Interbeds of limestone, cryptocrystalline, lithographic light grey-brown toward base of interval.
- 5055 - 5105' Limestone, light to dark brown, variably dolomitic (dolomite rhombs) cryptocrystalline to microcrystalline, lithographic and pelletoidal or lumpy, slightly argillaceous, and/or bituminous, crinoidal, may be few brachs, much bit damage. Numerous chips, white carbonate veins, trace tiny quartz crystals. Note: Probably much of the limestone encountered to date is largely crinoidal and recrystallized and hence difficult to determine. Have noted some crinoid ossicles with circular and five pointed star shaped canals. At 5070-90' almost certainly very crinoidal limestone. In many chips the fine grains are plainly visible but most appear structureless but some have faint "figure eight" canals of crinoid ossicles. The dry chips have that glitter which indicates the perfect cleavage of the recrystallized crinoid ossicles. Also some beds of shell debris which are represented by white, chalky, soft chips. Dolomitized corals and brachs poorly preserved.
- 5105 - 5125' Dolomite, variably calcareous (upto 30% white dolomite rhombs in brown limy matrix), light to dark brown, microcrystalline,

probably crinoidal with dolomitized corals and brachs, trace scattered small vuggy porosity, shows no gas kick or fluorescence in chloroethene.

- 5125 - 5140' Dolomite, very similar to above but mostly light to medium brown, better crystallinity, possibly grading to fine crystalline, better porosity with 30% of chips, showing small, vuggy, fossil porosity of 3-6%, with abundant pyrobitumen, no show.
At 5130-40' some streaks of porosity, may be 10% - probably coralline porosity, bitumen impregnated, noted large crinoid ossicle.
- 5140 - 5210' Dolomite, very slightly calcareous, mostly medium to dark brown, microcrystalline, well crystallized but only trace small vuggy porosity, visible crinoid columnals and stems, brach shells, argillaceous and/or bituminous.
- 5210 - 5233' Dolomite, variably calcareous, some very calcareous (white dolomite crystals in lime matrix), light to dark brown, microcrystalline, very similar to above, trace small vuggy porosity.
- 5233 - 5266' Dolomite.
See core description of Core #2. Remaining samples available.

Description by: N. Astill

- 5270 - 5300' 70% Dolomite, medium to dark brown, occasional patches black - possibly bitumen, very fine to fine crystalline, embedded with approximately 10% fossil fragments, white calcareous, coarse, some crinoidal, very poor inter-crystalline porosity and permeability.
Traces of fine calcite veining.
30% limestone, white, microcrystalline, fossiliferous, frequently crinoidal, no effective porosity or permeability.
The limestone appears to be present as patches within the dolomite, no definite interbedding or interlaminar is discernible.
In the 70% dolomite, the original matrix appears to have been altered to euhedral, equi-grained mosaic of brown dolomite, with the dark brown and black impurities, extended to the edges of the crystals.
The whole interval appears to be very similar to Core #2 5233-66'.
- 5300' - 5310' Frequent traces of limestone, white, soft, microcrystalline.

- 5310 - 5340' Dolomite/limestone sequence as 5270-5300' but ratios of approximately 50-60% dolomite, 50-40% limestone. Approximately 5-10% of the limestone is white, soft, microcrystalline. The proportion in the actual section is probably much higher, but is lost to the mud.
- 5350 - 5360' 20-30% dolomite, as 5270-5300'.
60-70% limestone, as 5270-5300' and with occasional traces limestone pellets in spar cement - Pelsparite.
Approximately 10% of limestone is soft, white, microcrystalline as 5310-5340'.
- 5360 - 5500' 30-70% limestone, light to medium brown, microcrystalline, fragmental (40-60%), chiefly bioclastic, fragments generally white, no effective porosity and permeability.
Frequent interlaminae of limestone, white, microcrystalline, soft, interbedded with: 70-30% limestone, dark brown, microcrystalline, bioclastic in part (40-60%), no effective porosity or permeability.
Appears to be partly dolomitized.
5370' Traces calcite crystals, coarse, white, probably fracture infilling.
5410' Frequent traces calcite, crystals, coarse, white, probably fracture infill.
5430-5450' Frequent traces calcite crystals, coarse, white, probably fracture infill.
5440' Traces of bitumen associated with the calcite veining.
5460-70' Up to 5% calcite crystals, coarse, white, probably fracture infilling.
5480-5500' Traces calcite crystals, coarse, white, probably fracture infilling.
- 5500 - 5740' Interbedded limestone, light to medium brown, microcrystalline to very fine crystalline, very poor intercrystalline porosity and permeability.
Limestone, dark brown, cryptocrystalline to microcrystalline, no effective porosity or permeability. Appears to be partially dolomitized with some coarsening of the crystal size to very fine to fine.
Traces calcite veining at 5500-5570', 5590-5620' and 5640'.
- 5740 - 5760' Limestone, dark brown to dark grey, microcrystalline, becoming increasingly dolomitized downwards and with apparent stringers of dolomite, dark brown, fine crystalline, with traces of poor intercrystalline porosity and permeability, no fluorescence or cut with chloroethene.

Blackstone River Dolomite 5770'

5770 - 5790' Limestone, dolomitic, dark brown to dark grey, very fine to fine crystalline with approximately 50% of the interval dolomite, dark brown, fine crystalline, poor to fair intercrystalline porosity and fine vugular porosity, traces of bitumen in the pores and vugs.
No oil staining noted, not cut with chlorothene.

Notes: See core description of Core #3. (5794-5822')

Description by: R. Carlyon

- 5790 - 5810' Dolomite, medium grey brown, dark grey in part, finely crystalline, calcareous, trace white crystalline calcite, looks fractured, traces very fine intercrystalline porosity (5%), with poor permeability.
5790-5800' 10-15% limestone, dolomitic, medium grey-brown, finely crystalline, dense and tight.
- 5810 - 5840' Dolomite, light grey-brown, medium grey brown in part, finely crystalline, trace fossils, white crystalline calcite and limestone, shows much bit damage.
5830-40' trace very fine intercrystalline porosity (5%).
5810-20' slightly calcareous.
- 5840 - 5850' Limestone, light-medium grey brown, fine to microcrystalline, dolomitic, trace fossils and white crystalline calcite.
- 5850 - 5890' Dolomite, calcareous, fine to microcrystalline, light to medium grey-brown, trace fossils, white crystalline, calcite and pyrite.
5880-90' trace very fine intercrystalline porosity (5%) and 5-10% limestone, dolomitic, fine to microcrystalline, medium grey brown, very dense and tight.
- 5890 - 5990' Dolomite, light grey brown, fine to microcrystalline, very slightly calcareous, traces fossils and white crystalline calcite, traces very fine intercrystalline porosity (5%) with poor permeability.
5920-60' becoming slightly calcareous (5-10%) and medium grey brown in part.
5960-90' becoming non fossiliferous, non calcareous.
- 5990 - 6060' Dolomite, light grey-brown, medium in part, fine to microcrystalline, very slightly calcareous in part, trace white crystalline calcite.
5990-6010' trace very fine intercrystalline porosity.

- 6000-10' trace fossils.
6020-30' trace pyrite.
6030-6040' trace bitumen.
6040-6060' trace (6%) vuggy and intercrystalline, fine porosity, fair permeability, trace white crystalline calcite and bitumen, trace also pyrobitumen.
- 6060 - 6070' Limestone, slightly argillaceous, medium to light grey, micro to cryptocrystalline, very dense and tight. 25% dolomite as above. Trace white crystalline calcite.
- 6070 - 6090' Dolomite, light grey, light to medium grey in part, very fine to microcrystalline, trace white crystalline calcite. 6080-90 trace (6%) very fine intercrystalline porosity. 6070-90 25-40% limestone, slightly argillaceous as at 6060-70'.
- 6090 - 6100' Limestone, trace argillaceous, medium to medium light grey very dense and tight, trace white crystalline calcite and bitumen. 25% dolomite as at 6070-90' with trace very fine intercrystalline porosity.
- 6100 - 6130' Dolomite, light to medium light grey in part, very fine to microcrystalline, very dense and tight, trace white crystalline calcite, pyrite and bitumen. 6100-20' 25-15% limestone, slightly argillaceous as at 6090-6100'.
- 6130 - 6320' Dolomite, slightly siliceous, light grey to light medium grey in part, extremely fine crystalline, hard, very dense and tight, generally traces bitumen and white crystalline calcite.
6150-60 medium grey to light grey in part.
6160-70 very minor trace vuggy porosity, (drusy lining).
6180-6200 slightly coarser crystalline, 30-40% becoming micro to very finely crystalline.
6180-90 medium grey to light medium grey in part.
6220-30 generally finely crystalline with trace fine vuggy porosity.
6240-70 no white crystalline calcite.
6270-80 40-70% becoming micro to very finely crystalline.
6280-90 becoming light grey, 70% finely crystalline, trace pyrite.
6290-6320' generally light grey, 60-80%, microcrystalline to cryptocrystalline, trace white crystalline calcite and pyrite.
- 6320 - 6430' Dolomite, slightly siliceous, generally medium light grey to light grey in part, trace white crystalline calcite and pyrite common, generally micro to cryptocrystalline with

10-20% micro to finely crystalline, very dense and tight, relatively hard.

6320-40' no white crystalline calcite.

6340-70' mainly light grey.

6350-6430' becoming very slightly calcareous.

6370-80' slightly argillaceous.

6390-6400' slightly argillaceous.

6400-30' slightly bituminous.

6430 - 6520'

Dolomite, bituminous, mainly light grey to medium in part and slightly mottled, black with bitumen, generally microcrystalline, some very finely crystalline, general trace white crystalline calcite and pyrite, generally slightly calcareous.

6440-50' trace only bitumen, sample light grey.

6460-6500' becoming quite (5%) calcareous.

6470-80' generally medium grey.

6480-6500' finely crystalline fraction 30%.

6490-6510' very small, trace vuggy porosity, dolomite light grey.

6480-6520' trace only bitumen, finely crystalline, fraction 30-60%.

6520 - 6570'

Dolomite, calcareous, bituminous, light grey to light medium grey in part, mottled black by bitumen in part, very dense and tight, mainly very fine to microcrystalline, traces white crystalline calcite.

6540-70 becoming mainly micro to cryptocrystalline.

6550-70' trace only calcareous and bitumen.

6560-70' trace fine vuggy porosity, poor permeability.

6570 - 6630'

Dolomite, calcareous, bituminous (pyrobitumen?) mainly microcrystalline, very finely crystalline in part, mainly light grey but 30-60% medium grey, general traces pyrite and white crystalline calcite.

6570-90' trace very fine vuggy porosity, poor permeability.

6580-90' trace stylolite.

6610-20' trace pyrobitumen.

6620-30' trace very fine vuggy porosity.

6650 - 6660'

Dolomite, pyrobitumen common, slightly calcareous, traces bitumen?, mainly light grey, mottled black with pyrobitumen in part, generally microcrystalline, some very finely crystalline, traces fine vuggy porosity throughout becoming more common at 6650-60'.

- 6660 - 6750'
6700' Dolomite, calcareous, medium grey, microcrystalline to very finely crystalline in part, scattered traces bitumen, white, crystalline calcite.
6660-70' common pyrobitumen.
6670-80' trace very fine vuggy porosity, poor permeability.
6660-80' trace siliceous.
6680-6700' becoming light grey with some medium grey.
6690-6700' trace fine vuggy porosity, poor permeability, common pyrobitumen.
- 6700 - 6850' Dolomite, common pyrobitumen, traces bitumen? scattered traces pyrite, light grey to mottled medium to dark in part, microcrystalline, some very finely crystalline in part, traces fine vuggy porosity throughout, slightly improved at 6700-10 and 6720-30' with fair permeability.
6770-6800' porosity, slightly better, average 5% permeability, poor to fair, generally very finely crystalline.
- 6850 - 7010' Dolomite, calcareous, very fine to microcrystalline, generally light grey to mottled, medium and dark by pyrobitumen, pyrobitumen is common, occasional trace pyrite and white crystalline calcite, generally poor, very fine vuggy porosity, 2% with poor permeability.
6870-90' generally medium grey due to abundant pyrobitumen.
6890-6910' trace only calcareous, porosity, slightly improved 4-5% with fair permeability.
6930-40 & 6950-60' generally medium dark grey, argillaceous.
6960-70' good porosity and permeability, approximately 7-8%.
- 7010 - 7070' Dolomite, fine to very finely crystalline, microcrystalline in part, light grey, mottled black with abundant pyrobitumen, very occasional traces of white crystalline calcite and pyrite.
Porosity, very fine vuggy, occasional intercrystalline, 3-6% permeability fair.
7020-30' porosity 10% with good permeability.
- 7070-7165' Dolomite, fine to very finely crystalline, microcrystalline in part, light grey, common black mottling due to pyrobitumen, occasional traces white crystalline dolomite and very slightly calcareous in part.
Porosity, generally very fine vuggy, only scattered traces, permeability poor.
7070-80' and 7100-10' generally medium grey.
7110-7165' medium grey in part.

Lower Devonian Limestone and Shale 7165'

- 7165 - 7200' Dolomite, argillaceous, dark grey to black, microcrystalline, very dense and tight, relatively hard, contains abundant

(5-10%) white crystalline calcite as fracture infilling, some finely disseminated pyrite, slightly calcareous in part.

7180-7200' becoming calcareous.

- 7200 - 7210' Dolomite, very fine to microcrystalline, light medium grey, trace pyrobitumen and possibly traces of fine vuggy porosity, traces white crystalline calcite and pyrite. 10% dark grey and argillaceous as at 7165-7200'.
- 7210 - 7240' Dolomite, argillaceous, dark grey to black, microcrystalline, slightly calcareous, traces pyrite and white crystalline calcite, looks bituminous in part, very dense and tight. 7210-20 5-10% white crystalline calcite filling fractures. 7220-40' traces medium grey, very finely crystalline. 7230-40' trace medium grey brown, cryptocrystalline, limestone.
- 7240 - 7250' Limestone, slightly argillaceous in part, medium grey brown, cryptocrystalline, very dense and tight, relatively soft, shows much chalkiness due to bit damage. Traces white crystalline calcite and pyrite. 35% dolomite as at 7210-40'.
- 7250 - 7260' Limestone, similar to 7240-50', microcrystalline to cryptocrystalline, more argillaceous, generally dark grey, traces argillaceous dolomite.
- 7260 - 7270' Limestone, very argillaceous, microcrystalline to cryptocrystalline, dark grey to medium in part, dense and tight, trace white crystalline calcite and pyrite, soft, traces shale, black, bituminous, slightly calcareous.
- 7270 - 7290' Limestone, very slightly argillaceous, medium grey brown, oolitic with some fine fraction and sparry calcite cement, very dense and tight, relatively soft, shows much bit damage, oolites have fossil fragments as nuclei. 7270-80' 20% very argillaceous, dark limestone as at 7260-70'. 7280-90' trace shale, black, very bituminous, slightly calcareous.
- 7290 - 7300' Limestone, very argillaceous, dark grey, microcrystalline, dense and tight. 10% oolitic as at 7270-90'. 5% shale, slightly calcareous, bituminous, black, very soft.
- 7300 - 7310' Limestone, medium grey, oolitic as at 7270-90'.
- 7310 - 7320' Limestone, very argillaceous as at 7290-7300' with trace fossil fragments, trace white crystalline calcite and pyrite.

- 5% shale, slightly calcareous, bituminous, black, soft, trace oolitic.
- 7320 - 7330' Limestone, slightly argillaceous, microcrystalline, medium grey brown, very dense and tight, traces oolitic, trace fossil fragments, trace black bituminous shale.
- 7330 - 7340' Limestone and 5% shale as at 7310-20', looks bituminous in part.
- 7340 - 7350' Limestone, very argillaceous, microcrystalline, medium dark grey, very dense and tight, 25% oolitic, slightly argillaceous, medium grey brown, dense and tight. 10% shale, very bituminous, slightly calcareous, soft, black.
- 7350 - 7430' Limestone, argillaceous, microcrystalline, medium grey brown, very dense and tight, contains a variable (10-60%) amount of fossil fragments, generally crinoids and brach fragments with a fine grained matrix, scattered traces white crystalline calcite and pyrite, occasional traces oolites. 10-15% shale, very bituminous, slightly calcareous, black, soft, fissile.
- 7430 - 7440' Shale, very bituminous, slightly calcareous, black, soft and fissile, contains traces fossil fragments. 15% limestone as above.
- 7440 - 7460' Limestone, very argillaceous, microcrystalline, medium grey brown, very dense and tight, contains 20% fossil fragments, generally crinoids and brachs. 25% shale as at 7430-40', traces pyrite and white crystalline calcite. 7350-60' 10% shale as at 7430-40'.
- 7460 - 7470' Shale, very bituminous, calcareous, black, soft and fissile. 25% limestone as at 7440-60'.
- 7470 - 7510' Limestone, argillaceous, microcrystalline, medium grey brown, contains 20% fossil fragments, generally crinoids brachs and ostracods, very dense and tight, traces pyrite. 7470-80' 40% shale as at 7460-70'. 7480-7500' 10-15% shale as at 7460-70'. 7500-7510' limestone becoming only slightly argillaceous with trace of shale.

- 7510 - 7520' Shale, very bituminous, calcareous, black, soft and fissile, trace fossil fragments and pyrite.
10% limestone as at 7470-80'.
- 7520 - 7560' Limestone, slightly argillaceous to very argillaceous in part, microcrystalline, medium grey brown, very dense and tight, contains 20% indistinct, fossil fragments, traces pyrite and occasional white crystalline calcite.
15-10% shale, very bituminous, calcareous, black.
7530-40' limestone becoming more argillaceous.
7540-50' limestone becoming very argillaceous.
- 7560 - 7570' Shale, very bituminous, calcareous, black, soft and fissile.
40% limestone as at 7520-7560.
- 7570- 7610' Limestone, argillaceous, microcrystalline, medium grey brown, very dense and tight, contains 10% poor fossil fragments, shows much bit damage.
10% shale, black, very bituminous, calcareous.
7590-7600' 40% shale as above.
- 7610 - 7840' Limestone, extremely argillaceous (40-50%) microcrystalline, generally dark grey, dense and tight, generally 5-10% poor fossil fragments, trace crinoid at 7610-20', traces pyrite, limestone could be bituminous in part.
5-10% shale, very bituminous, calcareous, black.
7630-7640' 25% shale as above.

Description by: W. Mudie

- 7840 - 7880' Limestone, coarsely to medium crystalline brown, extremely fossiliferous, trace of shale as above.
- 7880 - 7940' Shale, dark grey, calcareous, fossiliferous, scattered dolomite (white) veinlets, some pyrite and calcite.
- 7940 - 7950' Limestone, brownish grey, microcrystalline, some fossils, veinlets of white dolomite, argillaceous.
- 7950 - 7980' Limestone, as above, very slightly argillaceous.
- 7980 - 7990' Limestone as above, some light grey, chalky limestone, some limestone clean and non argillaceous.
- 7990 - 8000' Limestone, grey to light brown, medium crystalline, very fossiliferous, slightly argillaceous.

- 8000 - 8010' Limestone, grey to dark grey, microcrystalline, argillaceous, slightly fossiliferous, some limy shale.
- 8010 - 8020' Limestone, light grey to brown, microcrystalline, argillaceous, very fossiliferous, limy shale, as above.
- 8020 - 8060' Limestone and shale as above, 40-50% shale, fine veinlets of calcite.
- 8060 - 8100' Limestone, light grey to light brown, fine to medium crystalline, argillaceous, very fossiliferous in part. Scattered shale interbeds of shale, dark grey, limy in some part bituminous. Shale ranges 30-40%.
- 8100 - 8110' Limestone and shale as above to trace of dolomite, light grey, medium crystalline, some pyrobitumen staining, caving?, trace of chert, light grey.
- 8110 - 8120' Limestone and shale as above.
Quantity of dolomite increasing.
- 8121 - 8180' Limestone and shale. See core description of Core #4 (8121-8180').
- 8180 - 8200' Limestone, dark grey, slightly brownish, microcrystalline with some white calcite veinlets, argillaceous, shale, dark grey to black, limy in part.
- 8200 - 8250' Limestone, shale as above, a few chips exhibit calcite crystals, possible indication of open fractures.
- 8250 - 8410' Limestone and shale as above with veinlets of white calcite and light grey dolomite.
- 8410 - 8430' Shale, black, fissile, hard, calcareous.
- 8430 - 8440' Limestone, grey brown, fine to medium crystalline, fossiliferous, argillaceous, some dolomite, light grey, finely crystalline, possibly from fractures.
- 8440 - 8450' Limestone as above, with shale, dark grey and black, calcareous, both slightly bituminous.
- 8450 - 8490' Limestone, shale, as above, interbedded.
- 8490 - 8500' Shale, black, slightly calcareous, bituminous, fissile.
- 8500 - 8510' Limestone, greyish brown, finely crystalline, slightly argillaceous.

- 8510 - 8545' Limestone and shale as above, interbedded.
- 8545 - 8570' Shale, black, slightly calcareous, very hard-siliceous? , trace of pyrite, some calcite veinlets.
- 8570 - 8620' Limestone, grey brown, as above, interbedded with shale as above, scattered traces of chert to light coloured to clear.
- 8620 - 8650' Shale, dark grey, blocky in part, calcareous, pyritic, some scattered chert.
- 8650 - 8660' Limestone, grey brown, finely crystalline, fossiliferous in part, fossils replaced by white calcite and some white dolomite, argillaceous. Some isolated white dolomite, assumed from dolomite, filled fractures. Interbedded with shale, dark grey to black, slightly calcareous.
- 8660 - 8670' Limestone, dark grey, microcrystalline, argillaceous, bituminous in part, some shale, dark grey.
- 8670 - 8690' Limestone and shale as above.
- 8690 - 8700' Limestone, brown, fine to medium, crystalline, slightly argillaceous, isolated light grey to white dolomite and calcite, some dark grey to black, shale as above.
- 8700 - 8710' Limestone as above, fossiliferous, occasional dolomite chip with spotty pyrobitumen.
- 8710 - 8720' Limestone, grey brown, fine to medium, crystalline, fossiliferous, slightly argillaceous, noted two chips with drusy appearance, with open calcite crystals - open fractures?
- 8720 - 8740' Limestone, dark grey, microcrystalline, argillaceous, some limestone, grey brown, medium crystalline, as above, scattered veinlets of calcite.
- 8740 - 8770' Limestone, dark grey as above, slightly bituminous, interbedded to shale, black, slightly calcareous, occasional fragment of white dolomite.
- 8770 - 8800' Shale, dark grey, calcareous, in some part black and only slightly calcareous.
- 8800 - 8830' Limestone, grey brown, microcrystalline, argillaceous, interbedded with shale, as above, some isolated calcite crystals.
- 8830 - 8860' Limestone, grey, some very brown, microcrystalline, slightly argillaceous, bituminous in part, scattered crystals of calcite, some shale, as above.

8860 - 8880' Limestone, grey brown, microcrystalline, argillaceous, slightly bituminous in part, calcite filled fractures.

8880 - 8910' Shale, dark grey to black, slightly calcareous, some limestone as above.

?Silurian Shale and Limestone 8918' (G-S-C)

8910 - 8930' Limestone, dark grey to greyish brown, micro to finely crystalline, argillaceous, interbedded with shale as above, some calcite and dolomite, possibly from veinlets or fractures.

8930 - 8950' Shale, black, hard, slightly calcareous, siliceous.

8950 - 8980' Limestone, grey brown, microcrystalline, argillaceous, some fracture filling of calcite and dolomite, some shale as above. Chitinous Lingula - type brachiopods numerous.

8980 - 8990' Shale, dark grey, calcareous with some limestone as above .

8990 - 9000' Limestone gray to grey brown, as above.

Description by: W. Cowan

9000 - 9060' Shale, medium to dark grey, variably calcareous, probably due to very fine fossil fragments, homogeneous, tough, trace? silt 80-90%, grades to limestone, medium grey, argillaceous, microcrystalline, crinoidal but composed largely of tiny fossil fragments, trace tiny brachiopods, also trace pyrobitumen in calcite veins. Also traces large thin-shelled brachiopods and ?Chitinous Lingula - type brachiopods. Occasional masses, fine pyrite. At 9050-60' some very thin shelled, long brachiopods, resemble productids but are flattened and poorly preserved.

9060 - 9090' Limestone, medium grey, but microscopically mottled, microcrystalline, argillaceous, bioclastic, crinoidal and poorly preserved, thin shelled, brachiopods, similar to above, dense, (50%) grading to shale, as above. Trace ?fish plates and small white calcite veins.

9090 - 9120' Limestone as above 70%.
Shale as above.
Trace small white calcite veins.

9120 - 9190' Shale, dark grey, variably calcareous, homogeneous, tough some small white calcite veins. Traces poorly preserved

fossils, may be fish remains or chitinous brachiopods as above, slickensides.

At 9150-90' stringers of granular, friable, mottled, microcrystalline, limestone which may be composed of crinoidal debris, variable argillaceous content, trace pyrite crystals. Abundant indistinguishable chitinous (?brachiopods) and carbonaceous (?graptolites) films in shale.

At 9170-20' trace breccia, tiny rounded shale fragments in white calcareous matrix.

At 9180-90' noted one chip, showing fine crystalline, drusy, clear, calcite, face but no pyrobitumen.

- 9190 - 9200' Limestone, medium to dark grey, microcrystalline, variably argillaceous, crinoidal and other fossil debris, poorly preserved brachiopods, few small calcite veins, 70% grading to shale, dark grey, variably calcareous, microscopic, fossil debris, tough, numerous ? chitinous films.
- 9200 - 9210' Limestone as above, 30% grading to shale as above, 70%.
- 9210 - 9240' Shale, dark grey, variably calcareous, tough, homogeneous, texture, numerous chitinous or carbonaceous films of irregular shape and size (probably graptolites), microscopic fossil debris, some white calcite veins, grades to limestone 5-10%. Numerous slickensided surfaces.
At 9230-40' numerous chips of microbreccia of rounded shale fragments in white calcite matrix, apparently intra- or interformational breccia.
- 9240 - 9270' Limestone, medium grey, microcrystalline, variably argillaceous, very fine textured, possibly pelletiferous and crinoidal, few white calcite veinlets, 60% grading to shale as above.
- 9270 - 9280' Shale, medium to dark grey, variably calcareous, similar to above 80% grading to limestone as above, trace poorly preserved brachiopods and possible fish remains.
Few white calcite veinlets.

Upper Ordovician Limestone 9280'

- 9280 - 9292' Limestone, medium to dark grey, some with brown tint, (bit damage makes many chips look light-coloured), microcrystalline, variably dolomitic but chips will dissolve in acid without heating, fine textured and apparently almost barren of fossils, slightly argillaceous, few veins are probably responsible for small gas kicks.

(Note - pronounced slow drilling break here).

- 9292 - 9300' Limestone, medium to dark grey, variably argillaceous and generally more so than unit immediately above, microcrystalline, fine textured, possibly pelletiferous, probably crinoidal with other fine fossil debris. Noted few thin shelled, poorly preserved brachiopods ?fish plates and ?ostracod. Probably numerous stringers or patches of waxy black chert. No texture is apparent in the chert. Trace pyrite. Few white calcite veins.
- 9300 - 9338' Limestone, see core description of Core #5. Remaining samples available.
- 9338 - 9370' Limestone, dark grey, microcrystalline, very slightly argillaceous, very crinoidal, trace black chert. At 9360-70' possible horn corals with pyrobitumen in tiny cellular porosity, common in corals. No gas kick.
- 9370 - 9390' Limestone, very similar to above but variably dolomitic and a little lighter-coloured in part and a little coarser crystalline, very crinoidal, still just a trace of black chert, probably brachiopods and corals but poorly preserved.
- 9390 - 9492' Limestone, micro to cryptocrystalline, dark grey, sublithographic in part, crinoidal, no chert, ostracods. Trace 5% dolomitic, limestone, as above, but grades to dolomite, medium grey.

Ordovician Dolomite 9492'

Note: Fast drilling break here.

- 9492 - 9500' Dolomite, very slightly calcareous, medium to light grey, micro to very fine crystalline, saccaroidal, possibly crinoidal, trace very small vugs in few chips, trace pyrobitumen, gas kick, streaks of finely disseminated pyrite.
- 9500 - 9520' Dolomite as above, but micro to fine crystalline with more abundant pyrobitumen. Still very scattered, very small vuggy porosity, gas kick, negative chlorothene test under UV.
- 9520 - 9610' Dolomite as above at 9500-20' but no gas kick, some coarse white calcite vein or vug filling.
- 9610 - 9620' Dolomite, very slightly calcareous, light to medium grey, microcrystalline to medium crystalline, saccharoidal texture, possibly crinoidal, trace very small vugs and pyrobitumen, no gas kicks. Trace tiny quartz grains and/or crystals and pyrite crystals.

- 9620 - 9710' Dolomite, very similar to above, but micro to fine crystalline, mostly medium grey and very few chips show very small vuggy and intercrystalline porosity with a trace of pyrobitumen, no gas kicks. Trace tiny pyrite crystals. Coarse, crystalline, white, calcite. At 9630-40' noted cluster of well formed quartz crystals up to 1/10" in length; so must be some open larger vugs or fractures. Abundant white coarse crystalline calcite also.
At 9670-80' 5-10% of chips are medium crystalline, light grey dolomite with traces of pyrobitumen.
At 9690-9710' 5-10% of chips are medium crystalline, light grey dolomite with traces of pyrobitumen. Crystal aggregates of medium to coarse crystalline, white calcite, indicate large open vugs or fractures.
- 9710 - 9760' Dolomite, similar to above but micro to very fine crystalline, no porosity seen and no pyrobitumen. No gas kicks. Less coarse crystalline, white, calcite too. Very fine insoluble residue appears to be quartz silt.
- 9760 - 9790' Dolomite very similar to above but trace very small vugs and pyrobitumen in same.
- 9790 - 9800' Dolomite, very similar to above but possibly slightly lighter coloured, micro to very fine crystalline. A few chips show 2-4% very small vuggy porosity and a few vugs up to 1/8" with drusy, clear calcite, were noted. The porosity is not filled with pyrobitumen as is most porosity in the dolomite above. Gas kick over short interval about 9795'. Negative tests with chloroethene and carbon tetrachloride in UV light. Overall porosity and permeability poor and probably confined to small interval at 9795'.
- 9800 - 9830' Dolomite, very similar to above but just a trace of porosity in few chips which may be cavings from above. Trace pyrobitumen in intercrystalline porosity. Trace tiny pyrite crystals.
- 9830 - 9840' Dolomite, light to medium grey, micro to medium crystalline trace intercrystalline porosity, containing pyrobitumen, abundant coarse crystalline, white calcite from vug or vein fillings. No effective porosity, small gas kicks.
- 9840 - 9860' Dolomite, as above, with short intervals of good vuggy porosity, representing fossil or fracture fillings with drusy, calcite linings, gas kicks up to 200 units, only trace of pyrobitumen. Drilling breaks suggest 4' of porosity, negative chloroethene and CCl₄ test under UV light.

- 9860 - 9870' Dolomite, similar to above but mostly fine and medium crystalline, only trace of porosity. Gas kick diminishing.
- 9870 - 9880' Dolomite, as above, but some of chips have pyrobitumen in intercrystalline porosity, pores appear completely filled.
- 9880 - 9890' Dolomite, similar to above but micro to fine crystalline, no porosity seen and no gas kicks.
- 9890 - 9930' Dolomite, similar to above, mostly fine crystalline, trace intercrystalline porosity without pyrobitumen and occasional vug with drusy lining, no gas kick. At 9900-9910' noted one chip with what appeared to be very fine crystalline, drusy fracture surface.
- 9930 - 9950' Dolomite, as above but better intercrystalline and/or very small vuggy porosity with trace of pyrobitumen porosity, less than 4%, some coarse, white calcite, indicates larger vugs or veins. No gas kick. At 9940-50' definitely large calcite, lined vugs or veins with porosity but dolomite, becoming finer grained.
- 9950 - 9990' Dolomite, similar to above but micro to fine crystalline, only trace of intercrystalline porosity but may still be some larger vugs or veins. No gas kicks.
- 9990 - 10030' Dolomite, light grey, fine to coarse, crystalline, small and large open vugs, probably open drusy fractures, trace pyrobitumen, no gas kicks. Very few chips, actually show porosity yet it may be over 6% if large vugs and fractures are abundant.
- 10030- 10040' Dolomite, similar to above but microcrystalline to fine crystalline, occasionally medium crystalline. Trace intercrystalline porosity and few large vugs. No pyrobitumen and no gas kicks.
- 10040 - 10060' Dolomite, light to medium grey, mostly micro to very fine crystalline, trace intercrystalline porosity, probably few large vugs, no gas kicks.
- 10060 - 10090' Dolomite, similar to above, but mostly very fine to coarse crystalline, some small and large vuggy, porosity is good in a few chips, probably fractures - sawdust added when mud lost to formation. No gas kicks and no pyrobitumen.
- 10090 - 10160' Dolomite, mottled, medium grey and light grey, probably contains argillaceous matter, very fine to coarse crystalline, but the texture is more heterogeneous and granular looking

and even more friable than the dolomite above, trace intercrystalline and/or very small vuggy porosity, some large vugs and/or fractures, lined with white carbonate and occasional well formed quartz crystals, trace of pyrobitumen, no gas kicks.

At 10110-20' large vugs and fractures, more abundant.

- 10160 - 10220' Dolomite, similar to above but less noticeably mottled and more homogeneous texture, mostly medium to coarse crystalline, light and medium grey, dark ? argillaceous patches and streaks, trace small and large vugs, possibly fractures, no pyrobitumen and no gas kicks. Trace light green dolomitic shale in dolomite.
- 10220 - 10280' Dolomite, very slightly calcareous and possibly argillaceous, very fine to medium crystalline, mostly medium grey, trace large vuggy porosity, poorer than unit above, no pyrobitumen or gas kicks, fair to poor, small, vuggy porosity, better than unit above.

Description by: W.H. Nixon

- 10280 - 10290' Dolomite, calcareous, light grey, very fine to medium crystalline, finely crystalline fragments, have dull lustre, more coarsely crystalline, exhibit vitreous lustre. No trace of hydrocarbons, white euhedral crystals and fragments of white calcite and dolomite indicate possibility of large scale vuggy porosity, thin bands of white and light grey dolomite and calcite, may indicate infilling of fractures. Porosity 2% (pinpoint), (more with larger vugs). Permeability poor.
- 10290 - 10340' Dolomite, slightly calcareous, light to medium grey, very fine to medium crystalline, finely crystalline, fragments dull, more coarsely crystalline, fragments and crystals have vitreous lustre, white to light grey, euhedral, crystals and fragments of dolomite with minor calcite. No trace of hydrocarbons, possible large vuggy porosity, as in above interval. Porosity 2% (pinpoint) (more with larger vugs), permeability poor. At interval 10330-10340', small amount of pyrobitumen, residue noted, after dissolving coarsely crystalline fragments in HCl.
- 10340 - 10400' Dolomite, slightly calcareous, light-medium grey, fine-medium crystalline, finely crystalline fragments, dull lustre, the more coarsely crystalline with a subvitreous to vitreous lustre, light grey and white euhedral crystals and fragments

of dolomite (with minor calcite). Apparently more abundant than in the preceding interval, minor pyrobitumen residue.

Porosity 1-2%, vuggy, pinpoint.
Permeability, poor.

10400 - 10420' Dolomite, calcareous, medium grey, very fine-medium crystalline, lustre for the most part dull, larger crystalline fragments, exhibit a subvitreous to vitreous lustre. Light grey and white euhedral crystals and fragments of dolomite and calcite (evidently infill fractures and vugs), very minor pyrobitumen residue when fragments dissolved in HCl.

Porosity 1-2%, pinpoint, vuggy.
Permeability, poor.

10420 - 10500' Dolomite, calcareous, medium grey, (slight brownish tint?), very fine-medium crystalline, lustre, as in above interval, calcite and dolomite crystals as in above interval, minor pyrobitumen as in above interval, porosity and permeability as in above interval.

From 10450-500' - slightly more dark in color.

From 10470-480' - particularly poor porosity.

From 10470-500' - more finely crystalline.

10500 - 10510' Dolomite, argillaceous, medium-dark grey, very fine to medium crystalline, vitreous lustre, light grey and white euhedral crystals and crystalline fragments of dolomite and calcite, argillaceous, (pyritic?) residue when fragments dissolved in 10% HCl, small amount of bitumen in residue.

Porosity - 0-1%.

Permeability - poor.

10510 - 10540' Dolomite, argillaceous, dark grey, very fine, medium crystalline, vitreous, lustre, light grey and white euhedral crystals and fragments of dolomite and calcite (patches and fracture infillings), argillaceous and bituminous residue when fragments dissolved in 10% HCl (pyritic?). Oily hydrocarbon film present on top of acid after dissolving fragment.

Porosity - 0-1%.

Permeability - poor.

10540 - 10560' Dolomite, argillaceous, dark grey, very fine-medium crystalline, vitreous lustre, light grey and white euhedral crystals and fragments of dolomite and calcite, (fracture infillings and patches).

Subeuhedral-anhedral crystals of pyrite, rimmed by or red rusty halos, brittle black bitumen associated with white crystals of dolomite and calcite.

Porosity 0-1%.
Permeability - low.

- 10560 - 10600' Dolomite, a gillaceous, dark-medium grey, very fine-medium crystalline, vitreous to subvitreous lustre, minor pyrite to 10580', light grey, white euhedral crystals and fragments of dolomite and calcite, often minor amounts of brittle, black bitumen, associated with above crystals and fragments.
Porosity - 0-1%.
Permeability - low.
- 10600 - 10630' Dolomite, slightly calcareous, medium-light grey, very fine-medium crystalline, subvitreous to vitreous lustre, light grey to white, euhedral crystals and fragments of dolomite and calcite infilling fractures and vugs, occasional euhedral quartz crystal, no hydrocarbon residue.
Porosity - 0-1%. (Small pinpoint vugs noted 10610-620' interval in particular).
Permeability - low.
- 10630 - 10650' Dolomite, slightly calcareous and argillaceous, medium grey, fine-medium crystalline, vitreous to subvitreous lustre, light grey, white euhedral crystals and fragments of dolomite and calcite infilling fractures and vugs, no hydrocarbon residue.
Porosity 0-1%, permeability low.
- 10650 - 10700' Dolomite, slightly calcareous, light-medium grey (slightly brownish tint), very fine-medium crystalline, subvitreous-vitreous lustre, light grey-white, euhedral crystals and fragments of dolomite and calcite infilling fractures and vug.
Porosity 0-1%, permeability, low.
10690-10700' - slightly more coarsely crystalline.
- 10700 - 10720' Dolomite, as above, only slightly more dark in color.
- 10720 - 10760' Dolomite, slightly calcareous, medium grey-medium crystalline, subvitreous-vitreous lustre, no hydrocarbon residue noted, light grey-white euhedral crystals and fragments of dolomite and calcite infilling fractures and vugs.
Porosity 0-1%.
Permeability - low.
- 10760 - 10800' Dolomite, calcareous, medium grey, very fine-medium crystalline, subvitreous-vitreous lustre, light grey-white, euhedral crystals and fragments of dolomite and calcite infilling fractures and vugs, small amount of pyritic shale (cavings?), slight trace of hydrocarbon residue, porosity 0-1%, permeability low.
- 10800 - 10840' Dolomite, slightly calcareous, medium grey, very fine-medium crystalline, subvitreous-vitreous lustre, light grey-white euhedral crystals and fragments of dolomite and calcite infilling fractures and vugs, slight hydrocarbon residue.

Porosity 1-2% (vuggy-some fracture?).
Permeability - low.
10820-40' slightly more coarsely crystalline.

10840 - 10900' Dolomite, see core description of Core #6 (10840-10900').

10900-11110' Dolomite, calcareous, and very slightly argillaceous, medium grey, very fine to medium crystalline, lustre dull to subvitreous in more finely crystalline, vitreous to subvitreous in more coarsely crystalline, light grey and white euhedral crystals of dolomite and calcite infilling fractures and vugs, under 40X - occasional small crystals, pyrite, contains dark grey-black lumps (relict fossils?), occasional small fragments, dolomitic, shale containing small cubic crystals, pyrite (cavings?). Porosity 0-1%, permeability low.
10960-11110' slightly lighter in color.

Note: copied by W. Cowan from original by previous geologist.

Description by: W. Cowan

11110 - 11290' Dolomite, slightly calcareous, very fine to medium crystalline, medium grey with veinlets of white calcareous, coarse crystalline, carbonate patches of dark grey argillaceous matter, no intercrystalline porosity seen but occasional small vug noted in some samples, No gas kicks.
At 11130-40' abundant white carbonate veins but no porosity seen in them.
At 11190-11200' trace pyrobitumen in white carbonate vein.
At 11230-40' trace of drusy vugs of probable fossil origin.
At 11280-90' abundant large drusy vugs or veins lined with white carbonate with curved crystal faces suggesting dolomite, although it is calcareous, trace of very small vugs in country rock.

11290- 11340' Dolomite, very similar to above, intercrystalline and small vuggy porosity of 2% in 5-10% of chips which is better than unit above, no gas kicks.
At 11310-30' some drusy large vugs or veins.

11340 - 11430' Dolomite, similar to above but only a trace of small vuggy and intercrystalline porosity seen.
At 11380-90' some larger, drusy vugs.
Note: In core or hand specimen this dolomite would probable appear mottled, medium to dark grey, with white drusy vugs and veins.

- 11430 - 11510' Dolomite, very similar to above, mottled, but has better small vuggy porosity and considerable large, drusy vugs and veins of white carbonate - possibly 2-3%.
- 11510 - 11740' Dolomite, very similar to above, but only a trace of small and large vuggy porosity seen, less white carbonate in some samples but other contain considerable amounts of this vug and vein filling, probably completely filling them. At 11610-20' trace tiny pyrite crystals. At 11620-30' noted almost massive pyrite in small patches. Also one megascopic chip of pyrobitumen. At 11630-40' noted small vug with well formed, clear quartz crystals.
- 11740 - 11765' Dolomite, mostly light grey to white, some medium grey, very fine to medium and some coarse crystalline, possibly very slightly calcareous, pyrite crystals, most of white dolomite is coarse and probably vein and vug filling and most of the pyrite is in the white dolomite, no porosity seen, although there had been some intercrystalline porosity before the formation of the pyrite.
- 11765 - 11810' Dolomite, medium grey, some light grey, very fine to medium crystalline and white coarse veins and/or vug filling, slightly calcareous and slightly argillaceous, and/or bituminous in part, this would be a mottled rock in hand specimen, no porosity seen, no gas kicks.
- 11810 - 11813' Dolomite, very slightly calcareous, medium grey, micro to fine crystalline with ? lenses and ? irregular patches of medium grey chert 15%, some white carbonate veins. No porosity and no gas kicks.
- 11813 - 11830' Dolomite, very slightly calcareous, light grey, some medium grey, micro to fine crystalline with ? lenses and patches of light grey chert 10%. No porosity and no gas kicks, some white carbonate, veins are coarse crystalline.
- 11830 - 11840' Dolomite, very slightly calcareous and argillaceous, medium grey, micro to fine crystalline with numerous white carbonate veins and medium to dark brown-grey chert, 20% veins cut, chert as well as dolomite. No porosity or gas kicks. The chert contains darker rounded objects which are probably fossils or of organic origin.
- 11840 - 11850' Dolomite, very slightly calcareous and argillaceous, medium grey with light grey interbeds, micro to fine crystalline with numerous white coarse crystalline, carbonate veins, medium and light grey chert lenses 10% and occasional veins clear quartz, often cutting the chert. No porosity and no gas kicks.

- 11850 - 11860' Dolomite, very similar to above but only a trace of light grey dolomite and 5% chert.
- 11860 - 11870' Dolomite, medium to dark grey, very slightly calcareous and argillaceous, micro to fine crystalline with lenses of medium to dark brown-grey, chert 40% cut by clear quartz veins and white carbonate veins. No porosity or gas kicks.
- 11870 - 11890' Dolomite, very similar to above, but with only 10% dark chert, much of the chert appears brecciated with a matrix of white, coarse, crystalline carbonate, no porosity or gas kicks.
- 11890 - 11900' Dolomite, very slightly calcareous, light grey, micro to fine crystalline with veins, coarse, white carbonate, trace of pyrite, no porosity or gas kicks.
- 11900- 11910' Dolomite, very slightly calcareous, medium grey, micro to fine crystalline, trace of light grey chert, veins, white carbonate, no porosity or gas kicks.
- 11910 - 11940' Dolomite, similar to above but darker, medium to dark grey, probably argillaceous, micro to fine crystalline, 5-10% dark grey, chert, veins, white carbonate, no porosity or gas kicks.
- 11940 - 11960' Dolomite, very similar to above but possibly slightly lighter coloured (still medium grey, some dark grey) and a trace to 5% medium grey chert. Numerous white carbonate veins. No porosity, gas kicks.
- 11960 - 11990' Dolomite, similar to above but medium grey with only a trace of medium grey chert which is probably cavines. Abundant white carbonate veins, no porosity or gas kicks.
- 11990 - 12030' Dolomite, as above but no chert, becoming slightly lighter coloured downward, with some medium crystalline dolomite, trace vuggy porosity in white carbonate veins but no gas kicks.
- 12030 - 12150' Dolomite, light to medium grey, micro to medium crystalline, trace very small intercrystalline porosity and very small vugs in few samples but no gas kicks, white carbonate veins. At 12060-70' trace of larger drusy vugs.
- 12150 - 12170' Dolomite, similar to above but slightly more chips in fine to medium crystalline range, trace very small vugs, white carbonate veins.
- 12170 - 12240' Dolomite, very similar to above but fine to coarse, crystalline with abundant white veins, few chips with traces intercrystalline, and/or very small vuggy porosity. No gas kicks.

Trace fine crystalline pyrite.

At 12220-30' noted chip with possible white chert replacement of coralline structure - probably small stringer of chert.

- 12240 - 12260' Dolomite, mostly medium grey, some light grey, fine to coarse crystalline, possibly slightly argillaceous, 5-10% medium and light grey chert, probably in lenses preserving fossils, some chert breccia with white carbonate matrix, white dolomite veins, no porosity seen.
- 12260 - 12270' Dolomite, similar to above with 5-10% chert which does not have the glassy lustre of the overlying chert - it is dull, mottled, light to medium grey and brown with a fine granular texture and looks like the result of silicification of carbonate, more than the other glassy chert, no porosity seen, no gas.
- 12270 - 12320' Dolomite, light to medium grey, fine to coarse crystalline abundant, white carbonate veins, trace intercrystalline porosity, no gas kicks.
At 12300-12320' few very small vugs.
- 12320 - 12330' Dolomite, similar to above but mostly light grey, trace intercrystalline and very small vuggy porosity, no gas kicks.
- 12330 - 12360' Dolomite, similar to above but medium to dark grey, mottled with white coarse crystalline, carbonate patches and veins, probably argillaceous, no porosity seen and no gas kicks.
- 12360 - 12380' Dolomite, light grey and white, some medium grey, very fine to coarse crystalline, abundant white carbonate veins, vuggy porosity of various sizes, some with clusters of well formed, clear, quartz crystals, possibly 3-4% porosity, best seen for hundreds of feet. No gas kicks.
- 12380 - 12400' Dolomite, very similar to above with 2-3% light grey and white chert - probably silicification of fossils, trace of small vuggy porosity. Trace very fine crystalline pyrite.
- 12400 - 12420' Dolomite, medium grey, some light grey, fine to coarse crystalline, no porosity seen, white carbonate veins.
- 12420 - 12430' Dolomite, light grey and white, some medium grey with white carbonate veins showing, some larger vugs with clear calcite crystals, no gas kicks, trace white chert.
- 12430 - 12440' Dolomite, medium to dark grey ? interbedded with light grey, fine to coarse crystalline, the darker is probably argillaceous, white carbonate veins but no porosity seen.

- 12440 - 12450' Dolomite, light grey and medium grey, very fine to coarse crystalline, white carbonate veins, no porosity seen.
- 12450 - 12460' Chert, light grey and brown, white appears micro to cryptocrystalline, probably silicification of fossils (? stromatoporids) chips have a splintery habit. Dolomite 10-15%, light grey and white, very fine to coarse crystalline, no porosity seen.
- 12460 - 12490' Dolomite, white and light grey, fine to coarse crystalline, trace some vuggy porosity seen and no gas kicks, trace white chert as above, possibly cavings.
- 12490 - 12500' Dolomite, light to medium grey, fine to coarse crystalline, trace light grey, chert, white carbonate veins, no porosity seen, no gas kicks.
- 12500 - 12510' Dolomite, white to light grey, fine to coarse crystalline, white carbonate veins, traces light grey and medium grey, chert, no porosity seen, no gas kicks.
- 12510 - 12530' Dolomite, similar to above, but much of it is micro to fine crystalline, some coarse, trace light grey and white chert, white carbonate veins, trace pyrite crystals, trace small vuggy porosity, no gas kicks.
- 12530 - 12540' Dolomite, medium grey and light grey, micro to fine crystalline some coarse, no porosity, no gas kicks, trace chert.
- 12540 - 12550' Dolomite, light to medium grey, fine to coarse crystalline, white carbonate veins, trace chert, trace porosity, no gas kicks.
- 12550 - 12590' Dolomite, similar to above, light grey to white, some medium grey, also some very coarse crystalline, many chips have mottled appearance, white carbonate veins, trace small vuggy porosity, trace light grey chert - probably cavings.
- 12590 - 12600' Dolomite, medium grey, some light grey, fine to coarse crystalline, trace light grey and white chert, no porosity seen, no gas kicks, white carbonate veins.
- 12600 - 12620' Dolomite, similar to above but with 10-15% medium and light grey chert, no porosity seen, no gas kicks, white carbonate veins, trace pyrite crystals. At 12600-610' noted fossil imprint, resembling costate brachiopod.
- 12620 - 12650' Dolomite, mostly medium grey, fine to coarse crystalline, white carbonate veins, trace chert as above, possibly cavings, no porosity seen, no gas kicks.

- 12650 - 12660' Dolomite as above with 20% medium grey, chert in stringers, white carbonate veins, no porosity, no gas kicks.
- 12660 - 12700' Dolomite, medium to light grey, very similar to above, fine to coarse crystalline, trace medium grey chert as above - probably cavings, white carbonate veins with trace pyrite, no porosity or gas.
At 12690-700' abundant white vein carbonate.
- 12700 - 12730' Dolomite, medium to dark grey, slightly argillaceous, fine to coarse crystalline, white carbonate veins, give mottled appearance, no porosity, trace medium grey chert, may be cavings.
- 12730 - 12740' Dolomite, light grey and medium grey with white carbonate veins, mottled, fine to very coarse crystalline, trace very small vuggy porosity, no gas kicks.
- 12740- 12770' Dolomite, very similar to above, very small, vuggy and intercrystalline porosity, 3% in few chips.
At 12760-770' interbeds light grey to white, dolomite micro to fine crystalline.
- 12770 - 12780' Dolomite, light grey to white, some medium grey, micro to coarse crystalline, white carbonate veins, some with drusy vugs, small vuggy and intercrystalline porosity 3% in few chips but also indications of larger vugs, no gas kicks, no fluorescence.
- 12780 - 12798' Dolomite, light grey to white, some mottled, medium grey, micro to coarse crystalline, very similar to above but better porosity, mostly small vuggy porosity up to 5% in some chips, probably some larger vugs too, porous chips more abundant, white carbonate veins, no gas kicks.
- Note: +4' correction made in depth here so that 12794' becomes 12,798'.
- 12798 - 12812' Dolomite.
For description see Core #7 description.
Remaining sample available.
- 12812 - 12820' Dolomite, light grey to white with white carbonate veins, mostly fine to coarse crystalline, some microcrystalline, very small vuggy porosity, 3%, no gas kicks.
- 12820 - 12840' Dolomite, as above, with interbeds medium grey, mottled, dolomite, white carbonate, veins, trace light grey chert, trace very small vuggy porosity.

- 12840 - 12870' Dolomite, light grey to white, fine to coarse crystalline, with trace 5% white to light grey, chert, white carbonate veins, trace very small, vuggy porosity.
- 12870 - 12910' Dolomite, as above, but only trace of chert in some samples, which is probably cavings.
- 12910 - 12930' Dolomite, light grey to white, fine to coarse crystalline, trace to 3%, very small vuggy porosity, no gas kicks.
- 12930 - 12940' Dolomite, white to light grey, fine to coarse crystalline, white carbonate veins, trace very small, vuggy porosity, no gas kicks.
- 12940 - 12950' Dolomite, light grey to white, micro to fine crystalline, some coarse, crystalline, white carbonate veins, no porosity.
- 12950 - 12970' Dolomite, medium and light grey, micro to coarse crystalline, white carbonate veins, no porosity. The darker dolomite is probably argillaceous.
- 12970 - 13030' Dolomite, white to light grey, fine to coarse crystalline, white carbonate veins, no porosity.
At 12990-13000' few interbeds, medium grey, dolomite and trace light to medium grey chert.
At 13010-13020' trace of white chert.
- 13030 - 13110' Dolomite, as above, but with trace very small vuggy porosity, in some samples, some interbeds, microcrystalline and dense, no gas kicks.
- 13110 - 13120' Dolomite, light grey and white, micro to coarse crystalline, white carbonate veins, no porosity.
- 13120 - 13135' Dolomite, white to light grey, micro to coarse crystalline, white carbonate veins, no porosity.
- 13135 - 13170' Dolomite, medium to light grey, micro to coarse crystalline, probably argillaceous, white carbonate veins, trace pyrite.
- 13170 - 13180' Dolomite, very similar to above but with 2% medium and light grey and brown chert.
- 13180 - 13190' Dolomite, light grey to white, fine to coarse crystalline, white carbonate veins, no porosity.
- 13190 - 13210' Dolomite, light and medium grey, micro to coarse crystalline, white carbonate veins, darker dolomite, probably argillaceous, no porosity, no gas kicks.
- 13217' T.D. Driller.