

# NORTH DAKOTA GEOLOGICAL SURVEY CIRCULAR NO. 98

## Summary of the Carter - Emma L. Semling #1 Well Oliver County, North Dakota Well #15 - Permit #1

By Donald Towse and Sidney Anderson  
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The Carter Oil Company - Emma L. Semling well No. 1, Oliver County,  
North Dakota, C SE SE 18-141N-81W.

Elevation 2033 D.F., 2025 G.L., TD. 8850.

The Carter-Semling well was spudded June 8, 1942 & 13 3/8" surface  
pipe was cemented at 959 feet w/681 sacks of cement. The well was completed  
August 26, 1942, as a dry hole, plugged and abandoned.

Formation tops determined from sample and electric logs. Colors  
determined by rock color chart.

### Formation Tops

Cretaceous System	
Pierre	1090
Niobrara	2287
Greenhorn	2807
Dakota	3460
Jurassic	
Morrison	3677
Sundance	3827
Piper	4165
Triassic	
Spearfish	4360
Mississippian	
Amsden	4600 ?
Big Snowy Group	4704
Kibbey Lime	4935
Charles	5050
Mission Canyon	5425
Lodgepole	5750
Englewood	6350
Devonian	
Lyleton	6390
Nisku	6437
Duperow	6512
Souris River	6740
Dawson Bay	6925
Elk Point Group	7037
Silurian	
Interlake	7120
Ordovician System	
Upper Stony Mountain	7445
Lower Stony Mountain	7550

Red River	7645
Winnipeg Shale	8310
Winnipeg Sandstone	8465
Cambrian ?	
Deadwood?	8625
Pre-Cambrian	8835
Total Depth	8850

18-30	Clay, light olive, some lignite.
30-50	Clay, slightly bentonitic.
50-70	Clay, shell fragment (Pelecypod).
70-90	Sand, fine to medium grained angular, some frosted, some clay.
90-110	Lignite, shale olive gray.
110-130	Clay, light brownish gray.
130-150	Sand, dirty, clayey brownish black.
150-190	Clay, reddish brown, clay, gray.
170-210	Sand, fine grained, dirty, clayey, dirty gray.
210-230	Clay, brownish gray, small gypsum and limestone?
230-250	Clay, light brownish gray, brownish gray.
250-270	Sand fine grained, clayey light brownish gray.
270-310	Clay, brownish gray.
310-330	Clay, brownish and olive gray, some plant stems, some mica.
330-350	Clay, olive gray, micaceous.
350-370	Clay, ditto, sandy.
370-390	Clay, light olive gray.
390-410	Shale, micaceous, olive gray.
410-430	Sand, glauconetic fine grained subangular, shale ditto as above.
430-450	Sand, ditto, little shale dirty.
450-470	Sand, ditto, dirty.
470-490	Shale, brownish gray, some angular sand grains, slightly micaceous.
490-510	Shale, light olive gray, some sand, frosted, fine grained subangular and glauconitic, limestone white, fragment.
510-550	Shale, light brownish gray, some sand.
550-570	Shale, brownish gray, some very fine grained sand.
570-690	Sand, very fine grained glauconitic, very dirty, angular to subangular.
590-610	Shale, brownish gray, micaceous.
610-630	Shale, ditto, some sand.
630-670	Lignite and shale as above.
670-690	Shale, brownish black, micaceous lignite.
690-710	Shale and lignite as above. Sandstone medium grained frosted, subangular.
710-790	Sand, medium grained subrounded, much shale as above. 730-90 some shale.
790-810	Shale, brownish gray, some sand fine to medium grained.
810-830	Shale, ditto, some lignite fragments (out of place?)
830-870	Shale, ditto, sand, fine grained subangular.
870-890	Shale, light brownish gray and shale grayist red (scoria?)
890-910	Shale, light olive gray.
910-930	Sand, medium grained subangular to rounded, glauconitic, some shale.
930-950	Sandstone, ditto, little glauconitic, many shale, fragmental of sand size.
950-970	Sandstone, medium grained much amorphous quartz grains, subangular.

970-990 Sandstone, ditto, dirty.  
 990-1010 Sandstone, fine grained very dirty.  
 1010-1020 Shale, light olive gray.  
 1020-1030 Shale ditto and sand, medium grained glauconitic.  
 1030-1040 Shale ditto, glauconitic.  
 1040-1060 Shale ditto, glauconitic and micaceous, few sand grains.  
 1060-1070 Sandstone, fine grained micaceous, slightly glauconitic some shale.  
 1070-1090 Sandstone, fine grained, glauconitic mica pale yellowish brown dense, dolomite grains. Some shale.  
 1090-1100 Sandstone, ditto much light olive gray shale.  
 1100-1110 Sandstone and shale ditto, mica.  
 1110-1120 Missing.  
 1120-1130 Shale, olive gray and some sand grains.  
 1130-1150 Shale ditto. Inoceramus fragments.  
 1150-1160 Shale, brownish gray, bentonitic.  
 1160-1200 Shale, medium gray, bentonitic.  
 1200-1210 Shale ditto, some white limestone fragmental dense.  
 1210-1250 Shale ditto, micaceous.  
 1250-1260 Shale ditto. One brown rounded quartz grain.  
 1260-1270 Shale ditto with white ash? specks.  
 1270-1280 Shale, medium dark gray with much white limestone specks.  
 1280-1300 Shale ditto little white ash?  
 1300-1310 Shale ditto some pyrite. Some white ash?  
 1310-1320 Shale ditto Inoceramus fragmental white ash? dense fragment.  
 1320-1330 Shale ditto. Glauconitic grains, some brown shale fragment.  
 1330-1340 Shale, medium dark gray, shale light olive gray.  
 1340-1350 Shale N4 and 5Y6/1 50-50.  
 1350-1360 Shale in predonrinanc.  
 1360-1370 Shale and some silt, pale yellowish brown.  
 1370-1380 Shale bentonitic.  
 1380-1420 Shale ditto, some fine grained glauconitic sandstone.  
 1420-1430 Shale ditto, some mica.  
 1430-1450 Shale ditto, some white clayey limestone same as above.  
 1450-1470 Shale ditto. Fragmental of reddish sandstone.  
 1470-1480 Shale medium dark gray (n4) bentonitic.  
 1480-1490 Shale ditto, some white clayey limestone as above.  
 1490-1500 Shale ditto, some grains of glauconite.  
 1500-1510 Shale medium gray N5.  
 1510-1520 Shale ditto, some slightly darker.  
 1520-1530 Shale ditto, N4 and N5 about 50-50.  
 1530-1550 Shale N5 mainly, some mica.  
 1550-1560 Shale ditto, one fragment dense light olive gray dolomite 5Y6/1.  
 1560-1580 Shale ditto, slightly more fissile.  
 1580-1590 Shale ditto, some dense light olive gray limestone.  
 1590-1610 Shale ditto, one fragment black coaly stuff. Some pyrite and limestone.  
 1610-1620 Shale ditto, mainly n5. Some N4.  
 1620-1630 Shale ditto, N4 and N5 about 50-50 some calute and limestone.  
 1630-1640 Shale ditto as above. Fissile.  
 1640-1650 Shale, mainly N4 about 75% N5 about 25% shell fragmental.  
 1650-1660 Shale, N4 shell fragmental. Some white ash specks.  
 1660-1670 Shale N4 and N5 about 50-50.  
 1670-1680 Shale ditto, pelecypod shell fragmental.

1680-1690 Shale ditto, some aragonite and limestone.  
 1690-1700 Shale ditto, white ash fragmental.  
 1700-1720 Shale N5 some white ash.  
 1720-1740 Shale N4 and N5 about 50-50.  
 1740-1760 Shale ditto with white ash containing biotite.  
 1760-1770 Shale ditto, fragmental of light olive gray dolomite limestone.  
 1770-1790 Shale ditto with few fragments almost black sandy shale.  
 1790-1800 Shale ditto, some white ash.  
 1800-1810 Shale ditto, some light olive gray dense dolomite limestone 5Y6/1.  
 1810-1820 Shale N6 and limestone as above.  
 1820-1830 Shale ditto and white ash.  
 1830-1840 Shale N5.  
 1840-1850 Shale N5 5Y6/1 dolomite limestone argillaceous.  
 1850-1860 Shale ditto, some dolomite limestone as above.  
 1860-1870 Shale ditto and some white ash.  
 1870-1880 Shale ditto, white ash and some dolomite limestone pelecypod fragmental.  
 1880-1900 Shale, ditto and some dolomite limestone.  
 1900-1910 Shale N4 white ash, micaceous.  
 1910-1920 Shale ditto, shell fragmental.  
 1920-1930 Shale ditto with some moderate red 5R4/6 mottles.  
 1930-1940 Shale ditto, red streaks ditto, grayish fine grained red sandstone 5R4/2.  
 1940-1950 Shale ditto, pale brown 5YR5/2 dense limestone fragmental.  
 1950-1960 Shale ditto, some limestone as above.  
 1960-1970 Shale ditto, limestone ditto but more abundant.  
 1970-1980 Shale ditto, dolomite dense pale brown dolomite is ferruginous.  
 1980-2000 Shale ditto. Dolomite ditto.  
 2000-2010 Shale N6 and N7 some dolomite as above.  
 2010-2020 Shale N3 and N4 dolomite ditto, shell fragmental.  
 2020-2040 Shale ditto, dolomite abundant.  
 2040-2050 Shale ditto. Dolomite ditto, some white ash.  
 2050-2060 Shale ditto. Dolomite ditto, shell fragmental.  
 2060-2070 Shale N5, Dolomite less abundant.  
 2070-2090 Shale N3, much white ash.  
 2090-2110 Shale ditto, some dolomite as above.  
 2110-2120 Shale ditto, some with white specks?  
 2120-2140 Shale ditto, N5, some white ash.  
 2140-2150 Shale ditto, some white ash, some light colored siltstone.  
 2150-2170 Shale ditto, some dolomite.  
 2170-2180 Shale ditto, some silt.  
 2180-2190 Shale ditto, some moderated plant fragmental.  
 2190-2200 Shale ditto, some glauconite in white ash.  
 2200-2210 Shale N5, some dolomite and white ash, fissile.  
 2210-2220 Shale ditto, some dolomite, shell fragmental. Pyrite and limestone.  
 2220-2230 Shale ditto, Dolomite more abundant.  
 2230-2240 Shale ditto, Dolomite less abundant.  
 2240-2250 Shale ditto, less dolomite, fissile.  
 2250-2260 Shale ditto, some pyrite and limestone.  
 2260-2270 Shale ditto white ash micaceous, some dolomite.  
 2270-2280 Shale ditto, some silt some ash pyritized shell fragmental. Considerable dolomite.  
 2280-2290 Shale ditto, much ash some silt, some dolomite.  
 2290-2300 Shale ditto much ash little dolomite, some silt.

2300-2310 Shale N5 with white speckles, Calcareous. Top of Niobrara by samples E1 at 2290.  
 2310-2320 Shale ditto speckled slightly.  
 2320-2330 Shale N4 speckled.  
 2330-2340 Shale N3 and N4 speckled.  
 2340-2350 Shale N2 and N3 speckled.  
 2350-2360 Shale N5. Speckles and light spots. Probably calcareous can't see any trace of fossils here.  
 2360-2370 Shale N5 speckles found mainly in lighter colored fragments about N6.  
 2370-2380 Shale N6 speckles.  
 2380-2390 Shale ditto less speckled. Shell fragments pyrite and limestone.  
 2390-2400 Shale ditto few speckles some white ash.  
 2400-2410 Shale, medium light gray (N6).  
 2410-2420 Shale ditto some pyrite and limestone, shell fragments some speckles.  
 2420-2430 Shale ditto some speckled.  
 2430-2440 Shale ditto Globerigerins. Pyrite and limestone shell fragments.  
 2440-2450 Shale ditto fine grained glauconitic sandstone with mica. Pyrite and limestone  
 2450-2460 Shale ditto, considerable pyrite.  
 2460-2470 Shale ditto, some sand as above, some brownish gray dense dolomite 5YR4/1.  
 2470-2480 Shale ditto, little sand little dolomite.  
 2480-2490 Shale ditto very few sand grains.  
 2490-2500 Shale ditto much white ash.  
 2500-2510 Shale N5, some pyrite and limestone, shell fragments.  
 2510-2520 Shale ditto, some pyrite.  
 2520-2530 Shale ditto, some pyrite, some ash.  
 2530-2540 Shale ditto, some ash.  
 2540-2550 Shale ditto some pyrite.  
 2550-2560 Shale ditto some brown silt, shell fragments, some ash.  
 2560-2570 Shale ditto some pyrite, some brown dolomite.  
 2570-2580 Shale ditto some fine silt with glauconite, some pyrite and some brown dolomite.  
 2580-2590 Shale ditto, some pyrite.  
 2590-2600 Shale ditto, some pyrite shell fragments, some silt.  
 2600-2610 Shale ditto, pyrite and limestone arogonite crystalline.  
 2610-2620 Shale ditto, pyrite and limestone, shell fragments.  
 2620-2630 Shale dark gray (N3) silt.  
 2630-2640 Shale ditto small gastropod.  
 2640-2650 Shale N4 pyrite.  
 2650-2660 Shale (N4) fragmental of pale brown 5YR5/2 dolomite.  
 2660-2670 Shale ditto, some speckled gray shale.  
 2670-2680 Shale ditto, some pyrite and limestone and some black chert?  
 2680-2690 Shale ditto, pelecypod fragments pyrite on shell fragments.  
 2690-2700 Shale ditto pyrite and dolomite fragments.  
 2700-2710 Shale ditto pyrite, and dolomite fragments, shell fragments.  
 2710-2720 Shale ditto, pyrite and limestone, micaceous.  
 2720-2730 Shale ditto more bentonitic.  
 2730-2740 Shale N2 and N6 much pyrite.  
 2740-2750 Shale ditto N5 to brownish gray 5YR4/1  
 2750-2760 Shale N5 some pyrite.  
 2760-2780 Shale brownish gray 5YR4/1 dusky red 5R3/4 grain.

2780-2790 Shale ditto with gray connection.  
 2790-2800 Shale brownish black 5YR4/1.  
 2800-2810 Shale grayish black N2.  
 2810-2820 Shale ditto with some lighter shale.  
 2820-2830 Limestone white granular medium grained fragments(?) mostly shale as above.  
 2830-2840 Limestone is almost a micro-breccia. Mostly shale is sample.  
 2840-2850 Limestone and shale as above.  
 2850-2860 Shale brownish black 5YR2/1 and limestone as above.  
 2860-2880 Shale ditto with white specks of calcite is quite noticeable, shell fragments.  
 2880-2890 Limestone white granular, as at 2830-40. Pyrite and limestone, shell fragmental, much shale.  
 2890-2900 Limestone white, granular, pyrite and limestone.  
 2900-2910 Limestone and shale as above.  
 2910-2920 Shale brownish gray (5YR4/1) speckled with white calcite grains.  
 2920-2930 Shale as above with limestone white granular.  
 2930-2940 Shale as above and limestone ditto about 75-25.  
 2940-2950 Shale ditto much limestone, pyrite and limestone.  
 2950-2960 Shale N3.  
 2960-2970 Shale N2 with white calcite? specks, fissile good marker. Green mineral (glauconite?)  
 2970-2990 Shale brownish gray 5YR4/1.  
 2990-3000 Shale ditto, some limestone as above.  
 3000-3010 Shale ditto, much pyrite.  
 3010-3020 Shale ditto, some granular limestone.  
 3020-3030 Shale ditto, some speckled and some limestone.  
 3030-3040 Limestone gray white, granular, much shale as above.  
 3040-3050 Limestone and shale ditto.  
 3050-3060 Shale N3 and some limestone as above.  
 3060-3070 Shale ditto minor amounts limestone.  
 3070-3080 Shale ditto.  
 3080-3100 Shale ditto minor amounts limestone.  
 3100-3110 Shale N4.  
 3110-3120 Shale N3 some granular limestone.  
 3120-3130 Shale ditto shell fragmental.  
 3130-3140 Shale ditto some white specks.  
 3140-3150 Shale brownish black 5YR2/1.  
 3150-3160 Shale brownish gray 5YR2/1 some limestone light gray N7 granular.  
 3160-3170 Shale ditto some pyrite shale non-bentonitic.  
 3170-3180 Shale grayish black N2 some pyrite.  
 3180-3200 Shale ditto, some limestone as above, shell fragmental.  
 3200-3210 Shale N4.  
 3210-3220 Shale ditto, some light gray silty granular limestone.  
 3220-3230 Shale ditto, slightly bentonitic, some dark fragmental maybe plants?  
 3230-3240 Shale N3.  
 3240-3250 Shale N4, few limestone fragmental as above, non-bentonitic.  
 3250-3260 Shale N3.  
 3260-3280 Shale ditto some pyritic granular light gray limestone.  
 3280-3310 Shale ditto some brown slightly calcareous siltstone.  
 3310-3320 Shale ditto shell fragmental.  
 3320-3330 Shale N4 slightly bentonitic.

3330-3350 Shale ditto, some siltstone grayish red 10R4/2 pyrite and limestone.  
 3350-3360 Shale ditto some medium gray N5, siltstone calcareous.  
 3360-3370 Shale ditto, siltstone ditto one large sand grain.  
 3370-3380 Shale ditto, little siltstone.  
 3380-3390 Shale ditto, some siltstone grayish red 10R4/2.  
 3390-3400 Shale ditto focan Lenticulina, resin?  
 3400-3410 Shale N4 bentonitic.  
 3410-3420 Shale ditto not so bentonitic, fissile.  
 3420-3450 Shale ditto, fissile.  
 3450-3460 Shale ditto, fissile some fine grained siltstone.  
 3460-3470 Shale ditto, fissile, siltstone N5 fine grained.  
 3470-3480 Sandstone very fine grained (N6) much shale electro log places this top at 3465.  
 3480-3490 Sandstone, ditto many coarse rounded grayish red 10R4/2 sand grains, look like short grains, grains are so fairly angular. Much shale.  
 3490-3500 Sandstone mainly coarse grayish red grains.  
 3500-3510 Sandstone ditto plus fine grained gray silty sand and shale.  
 3510-3520 Shale N4.  
 3520-3530 Shale as above plus much sandstone as 3500-3510.  
 3530-3540 Shale ditto plus some sandstone, some white silty limestone pyrite.  
 3540-3550 Sandstone coarse, rounded, frosted, and subangular, clear and slightly pink much pyrite.  
 3550-3560 Sandstone as above much shale (cave?) pyrite.  
 3560-3570 Sandstone ditto much contaminated.  
 3570-3590 Sandstone ditto one fragment of reddish purple shale.  
 3590-3600 Sandstone ditto, sand has worn appearance.  
 3600-3610 Sandstone coarse grained dirty, cemented with pyrite fragment of pale red siltstone or shale.  
 3610-3620 Sandstone coarse rounded grains, not cemented with pyrite as above.  
 3620-3630 Sandstone as above, some pale red shale.  
 3630-3640 Sandstone as above, much gray shale (N4).  
 3640-3650 Sandstone ditto, much shale ditto.  
 3650-3660 Sandstone ditto, dirty, much pyrite.  
 3660-3670 Sandstone ditto, much shale grayish black N2, shell fragment.  
 3670-3680 Shale (N4) many sand grains, could be logged as sandstone.  
 3680-3690 Shale ditto and sandstone ditto, some pale red shale in very small amounts.  
 3690-3700 Shale dark gray N3, some dirty sandstone, shale is fissile and somewhat splintery.  
 3700-3710 Sandstone light olive gray (5Y6/1) dirty medium grained, many black fragments in sandstone (probably black chert) some glauconite in the sand.  
 3710-3720 Shale medium light gray N6, some sandstone as above.  
 3720-3730 Missing.  
 3730-3740 Sandstone medium fine grained, dirty light gray N7, some coarse sand, much shale as above.  
 3740-3745 Sandstone ditto much shale sandstone is glauconitic.  
 3745-3750 Missing.  
 3750-3755 Sandstone and siltstone and much shale (N4) sample mostly shale, pyrite present.  
 3755-3775 Missing.  
 3775-3780 Shale N4, some glauconite grains.

3780-3790 Missing.  
 3790-3795 Shale N3 dark gray, some sandstone as above.  
 3795-3800 Missing.  
 3800-3805 Shale dark gray N3, fissile, small tube of white material (worm burrow).  
 3805-3810 Shale ditto, sandstone fine grain light gray glauconitic.  
 3810-3815 Siltstone and fine grained sandstone (N6) glauconitic.  
 3815-3825 Missing.  
 3825-3830 Shale medium gray (N5) fissile.  
 3830-3840 Missing.  
 3840-3845 Sandstone white fine grained, glauconitic.  
 3845-3850 Missing.  
 3850-3860 Shale medium dark gray N4, some sandstone as above.  
 3860-3865 Shale greenish gray 5GY6/1 pencil like fragments.  
 3865-3870 Missing.  
 3870-3875 Shale 5GY6/1 to N6 some siltstone.  
 3875-3910 Missing.  
 3910-3920 Shale blackish red 5R2/2, sandstone medium grained subangular moderate pink 5R7/4 cast, shale olive gray 5Y4/1 siltstone, limy, shale brownish gray 5YR4/1 with black oil stain (?)  
 3920-3930 Sandstone medium to coarse grained, rounded, frosted glauconitic, clear to pinkish gray 5YR8/1, much olive gray shale.  
 3930-3940 Sandstone ditto.  
 3940-3950 Sandstone fine grained glauconitic very light gray X18 much greenish gray shale 5GY6/1.  
 3950-3960 Shale as above calcareous sandstone as above but less abundant.  
 3960-3970 Shale ditto calcareous 5GY6/1 with a little sandstone as above.  
 3970-3980 Shale ditto with white fine grained sandstone interbedded.  
 3980-3990 Shale light olive gray 5Y6/1 calcareous with some sandstone.  
 3990-4000 Shale greenish gray 5GY6/1 calcareous.  
 4000-4020 Shale ditto, also shale dark gray N3.  
 4020-4030 Shale ditto some medium grained sand.  
 4030-4040 Limestone white coarsely oolitics much shale as above.  
 4040-4050 Limestone ditto, much shale and sandstone from above.  
 4050-4060 Shale light olive gray 5Y6/1.  
 4060-4070 Shale ditto and shale brownish gray 5YR4/1 sandstone contamination.  
 4070-4080 Shale N4.  
 4080-4090 Shale ditto, some 5YR4/1 some very light grained (CHECK FOR CORE) siltstone.  
 4090-4100 Shale N6 to greenish gray 5GY6/1 calcareous.  
 4100-4110 Shale N6 ditto and siltstone, limy about N8 glauconite (?).  
 4110-4130 Shale and siltstone ditto.  
 4130-4140 Shale ditto calcareous, pyritized spore?  
 4140-4150 Shale ditto, sandstone fine grained glauconite light gray and siltstone moderate red 5R5/4 limy.  
 4150-4160 Limestone, clayey and silty grayish orange pink 5YR7/2, much greenish gray shale and some coarse, clear rounded, to subangular quartz grains.  
 4160-4170 Limestone pale brown 5YR5/2 silty and clayey, much other stuff as above.  
 4170-4180 Limestone white dense to very finely saccharoidal glauconitic, clayey?



4180-4190 Shale greenish gray 5GY6/1 and grayish black N2, some limestone as above.  
 4190-4200 Shale N6 with some silty limestone as above.  
 4200-4210 Limestone, white clayey dense, much shale as above.  
 4210-4220 Limestone ditto, some fine grained N8 sandstone glauconitic (in place?).  
 4220-4230 Limestone ditto.  
 4230-4240 Limestone ditto some limestone grayish pink much shale.  
 4240-4260 Limestone white dense.  
 4260-4270 Shale medium dark gray N4 and limestone as above.  
 4270-4280 Limestone white dense much shale as above.  
 4280-4290 Limestone ditto much shale.  
 4290-4300 Shale N5 a little anhydrite some limestone as above.  
 4300-4310 Shale N4 splintery pink and white anhydrite shell fragment.  
 4310-4320 Shale ditto some sandstone fine grained light gray glauconitic.  
 4320-4330 Limestone white dense dolomite pale red 5R6/2 dense.  
 4330-4340 Dolomite pale red silty much shale gray.  
 4340-4350 Dolomite ditto, white anhydrite much gray shale.  
 4350-4360 Shale N6 and dolomite as above, white anhydrite.  
 4360-4370 Dolomite moderate red 5R5/4 and shale ditto.  
 4370-4380 Sandstone very fine grained glauconitic, greenish gray, 5GY6/1 pink anhydrite.  
 4380-4390 Dolomite moderate red 5R5/4 silty white anhydrite much gray shale.  
 4390-4400 Shale moderate red much gray shale.  
 4400-4410 Sandstone fine grained pale reddish brown 10R5/4, dirty some shale as above and much gray shale cave.  
 4410-4440 Sandstone as above but fine to medium grain with some clear coarse quartz grains.  
 4440-4450 Sandstone ditto with some shale pale reddish brown 10R5/4 to moderate red.  
 4450-4460 Sandstone ditto 10R5/4 poorly sorted coarse and medium grain micaceous.  
 4460-4470 Sandstone ditto quartz grains rounded and pitted, red coles probably secondary.  
 4470-4480 Sandstone ditto.  
 4480-4490 Sandstone ditto dolomite? grayish red 5R4/2 dense, and sandstone moderate pink 5R7/4 medium grained small amounts white anhydrite.  
 4490-4500 Sandstone pale red 5R6/2 fine grained shale moderate red 5R5/4. Some sandstone as above.  
 4500-4510 Sandstone 5R6/2 fine grained but poorly sorted some shale, 5R5/4.  
 4510-4520 Sandstone ditto, shale ditto, dolomite 5R4/2 dense some sandstone medium grained white to 5R6/3.  
 4520-4530 Sandstone, shale and dolomite as above, considerable white anhydrite, much gray shale (contamination?).  
 4530-4550 Sandstone fine grained pale red 5R6/2 shale medium grained N5.  
 4550-4560 Sandstone ditto some anhydrite white, much N5 shale.  
 4560-4570 Shale moderate red 5R5/4 dolomite 5R5/4 dense, white anhydrite.  
 4570-4580 Shale pale reddish brown 10R5/4 and some sandstone light olive gray 5Y6/1 very fine grained, glauconitic (?) and much gray shale.  
 4580-4590 Shale and limestone grayish red 5R4/2 and much gray shale medium dark gray.  
 4590-4600 Sandstone pale red 5R6/2 and white shale 5R5/4 and much gray shale N5 some bentonite.

4600-4610 Dolomite light brownish gray 5YR6/1 very fine grained almost a siltstone, sandstone white, shale moderate red 5R4/6.

4610-4620 Dolomite as above and sandstone as above.  
 Coring 4611-4621 #4 core recovery 2'  
 2" Sand, dark gray, very very fine, very hard, very tight, argillaceous.  
 10" Shale, medium gray, very very fine, sandy, dolomitic, red shale.  
 10" Dolomite, pink to lavender, dense to finely crystalline with embedded mosses sand, very fine gray gypsiferous.  
 2" Mass of sand, gray, very fine and anhydrite, gray, granular (sand) embedded in anhydrite matrix).

4620-4630 Dolomite 5YR6/1 dolomite moderate pink 5R7/4 very porosity some pyrite.

4630-4640 Sandstone grayish pink 5R8/2 to white fine to medium grained and dolomite as above.

4640-4650 Sandstone as above much contamination, some anhydrite.

4650-4660 Shale light olive gray 5Y6/1 splintery fragments, some sandstone and dolomite as above.

4660-4670 Shale as above much contamination. Sandstone and dolomite as above.

4670-4680 Sandstone pinkish gray 5YR8/1 much contamination Bolemnite fragment.

4680-4690 Core #5 10' recovery (4683-4693)  
 2'2" Sand, dark gray, very very fine, very very tight and hard, very argillaceous, dolomite.  
 1'8" Shale, very black, carbonaceous, finely micaceous, occasional vertical seam of silenite, variety gypsum, Orbiculoidea sp. and conodonts.

4680-4690 6" Sand light black, very very fine, very very hard, very micaceous, very argillaceous, dolomite.  
 9" Sand as above with thin seams of gypsum few vertical fractures filled with gilsonite (?)  
 4" Interbedded black shale and very fine quartzitic gray sand.  
 9" Shale light black hard, earthy, finely micaceous.  
 1'9" Shale black, very micaceous, greasy appearance, salty taste.  
 2" Dolomite, buff gray, oolitic, abundant fossil fragments, fair vugular porosity, cherty, very hard.

4690-4700 Core #6 4933-4703 Recovery 4'4".  
 4'4" Dolomite, gray oolitic, very hard, abundant fossil fragments fair gray vugular porosity.  
 6" Dolomite gray very dense, (lithographic).  
 5" Dolomite, as above, streaks fine gray sand.  
 2'2" Anhydrite, white granular to crystalline.  
 3" Shale, black very dense, very hard lithographic.  
 8" Shale, black and anhydrite white granular (lost recovery probably black shale).

4700-4710 Shale grayish black N2, splintery, limestone, sandstone, dolomite as above.

4710-4720 Shale N2, dolomite pale olive 10Y6/2 mottled with pale reddish brown 10R5/4 mottles.

4720-4730 Shale N2, shale N7, much bentonite (drilling mud) (contaminated).

4730-4740 Shale N2 limestone grayish red 5R4/2 clayey (contaminated).

4740-4750 Shale N2, dolomite light brownish gray 5YR6/1 pyrite and limestone (contaminated).

Core #7 4738-4748 Recovery 5'10"

1'9" Dolomite white finely granular, gypsiferous.

4" Shale medium gray, hard dolomitic.

8" Shale, light black soft greasy feeling.

3" Dolomite gray granular to shaly seams of white anhydrite.

2' Shale green, soft, sticky gypsiferous.

4750-4760 Shale medium dark gray (N4) siderite nodules, limestone light brownish gray (5YR6/1).

4760-4770 Limestone grayish pink 5R8/2 (more or less) very oolitic, medium crystalline.

Core #8 4765-4775 Recovery 7'9".

8" Limestone, buff to brown, fine to medium crystalline, fossil fragment.

4" Limestone, brown, very oolitic, 1 fish scale.

4" Limestone, tan, dense to finely crystalline patches dolomite, brown crystalline.

10" Dolomite, gray, hard dense to granular.

1" Anhydrite granular, bright orange red.

8" Shale, olive green, granular, red anhydrite inclusions.

2'10" Dolomite, dark green gray, granular to dense, argillaceous, shaly.

2' Shale, black carbonaceous, very calcareous, hard, ostracods (2'3" lost recovery was probably at base of core - hard dolomite).

4770-4780 Shale pale yellowish brown 10YR6/2 dolomite pale red (5R6/2) dense. Shale (N4) splintery.

4780-4790 Shale N6, (much contamination), limestone white, dense dolomite as above.

4790-4800 Shale N4, much contamination.

4800-4810 Shale (N4) bituminous looking, limestone white, dense shale dark yellowish brown 10YR4/2.

4810-4820 Shale (N5), limestone white dense glauconitic.

4820-4830 Dolomite white to grayish orange pink (10R8/2) dense vugular porosity, fossiliferous with small gastropod of cyclonema type.

4830-4840 Shale pale yellowish brown (10YR6/2) and grayish red (5R4/2). Dolomite as above. Limestone fossiliferous (10YR6/2) to white.

4840-4850 Shale grayish red (5R4/2) also some 10YR6/2 intermottled some coarse clear and frosted quartz sand grains.

4850-4860 Shale moderate red (5R5/4).

4860-4870 Shale grayish red (5R4/2).

4870-4880 Shale as above, shale (1Y6) splintery.

4880-4890 Shale greenish gray (5GY6/1) pyrite and limestone (good other shale color).

4890-4900 Siltstone, micaceous, light olive gray (5Y6/1) some shale as above.

4900-4910 Shale greenish gray (5GY6/1) nearest color, more gray than green some fine grained sandstone of same color.

4910-4920 Shale and sandstone as above.

4920-4930 Shale (5GY6/1) pyrite and limestone sandstone as above.

4930-4940 Shale (5GY6/1) shale grayish red, (5R4/2) with coarse sand grains embedded.

4940-4950 Anhydrite, white and light gray (N7) shale as above, pyrite and limestone.

4950-4960 Limestone white, dense to fragmental slightly oolitic, slight vugular porosity shale medium gray N5 sample contaminated.

Coring.

Core #9 4947-4957 Recovery 4'3".

1'8" Limestone, buff, granular, sandy, hard.

10" Limestone, buff, granular, soft.

2" Limestone, buff, granular to finely crystalline.

1" Shale, green, greasy feeling.

1" Anhydrite, white granular, sandy.

1'5" Shale, green, soft and limestone, buff, granular, very soft.

(Lost recovery probably limestone, and green shale interbedded).

- 4960-4970 Shale grayish red (5R4/2), shale light olive gray 5Y6/1 with glauconite, some pyrite, some mottled red and green gray shale, coarse rounded frosted sand grains.
- 4970-4980 Shale grayish red as above, clay with red mottles or pellets, sandstone fine grained, light olive gray 5Y6/1, calcareous.
- 4980-4990 Shale grayish red as above, some coarse sand grains.
- 4990-5000 Shale as above, sand grains as above.
- 5000-5010 Shale as above, also sandstone fine grained, gray shale (cave) anhydrite, white.
- 5010-5020 Shale as above, sandstone fine, grained, medium light gray pyrite coarse sand grains.
- 5020-5030 Shale as above, shale medium dark gray (N4).
- 5030-5040 Sandstone medium to coarse grained, mostly sand grains rounded and frosted, shale as above.
- 5040-5050 Sandstone as above, shale grayish red 5R4/2. 50-50?
- 5050-5060 Limestone brownish gray 5YR4/1 dense to oolitic, some oolitic have black centers, dolomitic, oolitic very prominent.
- 5060-5070 Limestone oolitic ditto, Oscaacod.
- 5070-5080 Limestone dense light gray N7 and limestone very coarse oolitic with intergranular porosity.
- Core #10 5069-5079 Recovery 7'.
- 8" Limestone, gray, argillaceous, granular to finely crystalline, crinoid stems.
- 6" Limestone, buff, dense to finely crystalline, dark brown patches, looks like dried up oil, but won't test as such.
- 1' Limestone, gray dense to finely crystalline dark brown patches as above.
- 2'9" Limestone, gray to dark buff, dense occasional black carbonaceous shale partings with little disseminated dark brown material as above.
- 6" Limestone, buff, finely crystalline, dolomitic fossil fragments.
- 7" Limestone, gray to brown, finely crystalline, dark brown patches as above.
- 5" Limestone, buff, dense, very hard, few scattered vugs.
- 7" Limestone, dark buff, granular, slightly oolitic. Lost recovery probably limestone.
- 5080-5090 Limestone oolitic, very coarse, light gray N7, intergranular porosity, some oolites have black centers.
- 5090-5100 Shale olive gray 5Y4/1 greasy looking shale light brown 5YR5/6 shale grayish red 5R4/2 anhydrite white crystalline.
- Core #11 5097-5102 Recovery 3'3".
- 3'3" Anhydrite, white dense, hard.
- 5100-5110 Anhydrite white, crystalline, shale olive gray 5Y4/1 (shale grayish red 5R4/2).

5110-5120 Shale and anhydrite as above, contaminated, some sandstone gray, medium to fine grained.

5120-5130 Shale medium light gray (N6) anhydrite white, crystalline some sandstone as above and some oolitic limestone as above.

5130-5140 Shale moderate red (5R5/4) shale as above anhydrite as above.

5140-5160 Limestone very pale orange (10R8/2) very silty almost a silt.

5160-5170 Limestone ditto, same shale medium dark gray (N4).

5170-5180 Shale dark reddish brown 10R3/4 limestone as above, gray shale as above.  
Core #12 5182-5183 1/2 Recovery 8".  
8" Anhydrite, dense, hard, embedded pyrite.

5180-5190 Shale N4, anhydrite, white, crystalline.

5190-5200 Shale N4 anhydrite white, dense.

5200-5210 Limestone grayish grange pink (5YR7/2) silty medium crystalline, slightly oolitic? some dark specks in limestone, ostracod.

5210-5220 Shale medium dark gray (N4) much pyrite limestone as above.

5220-5230 Shale grayish red 5R4/2 with gray mottles, some shale dark reddish brown (10Rs/4) shale gray as above.

5230-5240 Shale as above, anhydrite, white, dense, ostracod.  
Core #13 Recovery 5' full recovery 5234-5239.  
2'8" Anhydrite, dark blue gray, dense very hard.  
2'4" Anhydrite, dark blue gray, dense to granular.

5240-5250 Anhydrite, light bluish gray 5B7/1 and white.

5250-5260 Limestone light gray (N7) soft medium crystalline, dirty anhydrite white dense.

5260-5270 Limestone light brownish gray (5RY6/1) dense, limestone as above and anhydrite.

5270-5280 Limestone as 5250-60.

5280-5290 Limestone as above, anhydrite light bluish gray and white, dense.

5290-5300 Anhydrite as above and red and gray shale (probably cave).

5300-5310 Shale medium dark gray (N4), anhydrite, white dense, limestone oolitic, shale dark reddish brown (10R/34) (cave?).

5310-5320 Anhydrite white dense, dolomite? dense light gray.

5320-5330 Limestone, grayish orange pink 5YR7/2, oolitic with dark specks.

5330-5340 Limestone, pale brown 5YR5/2, saccharoidal porosity vugular and pinpoint mainly latter, looks like it might be OIL STAINED, silty.  
Core #14 5339-5344 Recovery 1'2".  
2" Limestone, black, very dense, very hard.  
10" Limestone, buff, granular, fair porosity, slight odor and taste of oil, ostracods a sponge spicules.  
2" Limestone, buff, dense to granular embedded masses of dolomite, brown coarsely crystalline, salty taste.  
Core #15 5344-5349 Recovery 4".  
4" Limestone, medium gray, dense, shaly, hard, salty taste.  
3" Limestone, buff, granular, salty taste.  
1" Limestone, light gray, dense, shaly, hard, salty taste.  
Core #16 5349-5354 Recovered 4'4".  
4'4" Anhydrite, dark gray, dense, very hard.

5340-5350 Limestone light brownish gray 5YR6/1, dense vugular porosity, anhydrite white dense.

5350-5360 Anhydrite, light bluish gray (5B7/1).

5360-5370 Anhydrite, medium bluish gray (5B5/1).

5370-5380 Shale dark gray (N3).

5380-5390 Anhydrite, medium bluish gray (5B5/1) and (5B7/1).

5390-5400 Limestone very pale orange 10R8/2, dense, anhydrite 5B7/1.  
 5400-5410 Anhydrite, 5B7/1.  
 5410-5420 Anhydrite, light gray (N7), some pyrite.  
 5420-5430 Anhydrite as above, limestone dense, pale yellowish brown 10YR6/2 with black speckles (stain?)  
 5430-5440 Anhydrite and limestone as above, limestone in slight saccharoidal and oolitic. Some oil stain? in limestone.  
 5440-5450 Limestone very pale orange 10YR8/2, vugular and intergranular porosity, saccharoidal.  
 5450-5460 Limestone pinkish gray 5YR8/1, clayey, finely saccharoidal.  
 5460-5470 Limestone ditto vugular porosity good.  
 5470-5480 Limestone grayish orange pink 5YR7/2 very vugular porosity fragments.  
 5480-5490 Limestone ditto some black stain, vuglar porosity.  
 5490-5500 Limestone ditto black stain, vugular porosity.  
 Core #17 Recovery 1" 5500-5505  
 1" Limestone, light brown, granular, slight porosity, small inclusions of anhydrite, white granular.  
 Core #18 Recovery 6" 5505-5515  
 6" Limestone, light and dark brown, mottled, granular and crystalline, dolomitic, slight porosity; abundant spicules; tighter limestone, has very salty taste, salt water probably flushed out of more porous limestone by drilling fluid.  
 5500-5510 Limestone ditto, good vugular porosity and intergranular porosity.  
 5510-5520 Limestone ditto, saccharoidal and fragmental, some black stain.  
 5520-5530 Limestone ditto more fragmental and oolitic. Some crinoid? stains.  
 5530-5540 Limestone ditto, fragmental, oolitic some black stain.  
 Core #19 Recovery 1'8" 5531-5536  
 1'8" Limestone, medium brown, granular to finely crystalline, medium hard few crinoid stems.  
 5540-5550 Limestone ditto, fragmental some vugular porosity.  
 5550-5560 Limestone ditto, little porosity.  
 5560-5570 Limestone ditto, dirty sample, considerable pyrite (float?)  
 5570-5580 Limestone ditto, fragment and oolitic, crinoid stem.  
 Core #20 Recovery 3' 5575-5580  
 1'4" Anhydrite, dark gray, dense, shaly appearance.  
 8" Anhydrite, gray to white, granular to crystalline.  
 1' Anhydrite, dark gray, dense, shaly appearance.  
 5580-5590 Anhydrite, pale blue, 5PB7/2.  
 5590-5600 Anhydrite, ditto and white.  
 5600-5610 Limestone grayish orange pink 5YR7/2 and anhydrite as above.  
 5610-5620 Limestone ditto with black stain; anhydrite as above; sample contaminated.  
 Core #21 Recovery 1'3" 5614-5619  
 2" Dolomite, brown, dense to granular, hard.  
 1" Limestone, brown gray, very oolitic (large), medium crystalline, tight hard.  
 1" Dolomite, buff, dense, hard, anhydrite inclusions.  
 9" Dolomite, tan, dense to granular, hard.  
 2" Dolomite, buff, dense, hard, anhydrite inclusions.  
 5620-5630 Sandstone light brownish gray 5YR6/1, very fine grained, almost a silt, intergranular porosity; limestone very oolitic with black stain, color as above.  
 Core #22 Recovery 1'4" 5625-5635

2" Sand, brown, very very fine, fair porosity (siltstone), dolomitic finely micaceous.

1'2" Limestone, buff to brown, dense to finely crystalline, vugular porosity and limestone, buff to brown, oolitic (large) good porosity (interbedded); coring sample and drilling time shows sand 5625-5626 and limestone 5626-5635 as above.

5630-5640 Sandstone as above; limestone pinkish gray 5YR8/1, oolitic and fragmental, intergranular and vugular porosity.

5640-5650 Limestone ditto, coarsely oolitic, vugular porosity.

5650-5660 Limestone ditto, oolitic and fragmental vugular porosity.

5660-5670 Limestone ditto, very oolitic, no porosity.

5670-5680 Limestone, ditto very coarsely oolitic and fragmental little porosity.

Core #23 Recovery 10" 5675-5685

5" Limestone, buff, very oolitic (large), hard, very porous, crinoid stems.

5" Limestone, buff, oolitic, fossil fragments (brecciated appearance); Schurhuteella sp; cup corals (coring sample for 5675-85 shows limestone as above.

5680-5690 Limestone, light brownish gray 5YR6/1, fragmental and oolitic, vugular porosity in small amounts, some secondary calcrite.

5690-5700 Limestone ditto.

5700-5710 Limestone ditto, slightly more oolitic, little or no porosity, crinoid stems.

5710-5720 Limestone grayish orange pink 5YR7/2 very oolitic, some vugular porosity.

5720-5730 Limestone ditto also fragmental, much of this color indicated above would be called buff ordinarily.

5730-5740 Limestone light gray N7, dense to slightly fragmental; non-porosity.

5740-5750 Limestone ditto to N4, non-porosity.

5750-5760 Limestone light brownish gray 5YR6/1 dense; non-porosity dense; crinoid stem.

5760-5770 Limestone ditto n4 1, some pyrite.

5770-5780 Limestone ditto, brachiopod fragment.

5780-5790 Limestone ditto.

5790-5800 Limestone dense, grayish orange pink 5YR7/2; limestone ditto coarsely oolitic.

5800-5810 Limestone ditto with small infrequent red mottles; limestone oolitic ditto, oolitic limestone has vugular porosity.

5810-5820 Limestone dense medium gray N5.

5820-5830 Limestone, ditto.

5830-5840 Limestone, ditto dense to slightly fragmental, crinoid stems.

5840-5860 Limestone ditto with some lighter dense limestone.

5860-5870 Limestone ditto some fragments of fossils.

5870-5890 Missing.

5890-5900 Limestone, ditto, tight.

5900-5910 Limestone, N5 dense to slightly fragmental, brachiopod fragment, tight.

5910-5920 Limestone ditto Lengulu type brachiopod fragment. Limestone, light brownish gray 5YR6/1 dense to fragmental tight.

5920-5930 Limestone, light brownish gray 5YR6/1 dense to fragmental, tight.

5930-5940 Limestone N5 dense to fragmental, tight.

5940-5950 Limestone, ditto, tight.

5950-5960 Limestone N6 finely fragmental, brachiopod fragmental, tight.  
 5960-5970 Limestone N5 ditto to dense, black oil stain in cracks?  
 5970-5980 Limestone n6 dense to fragmental, tight.  
 5980-5990 Limestone, ditto, fossil fragments, tight.  
 Core #24 Recovery 2'2" 5980-5990  
 8" Limestone, dark gray, very hard; cemented mass of brackenpods  
 and crinoid stems.  
 1'6" Limestone, dark green gray, dense, to granular, argillaceous,  
 finely micaceous, dolomitic, two masses of quartz crystals; some  
 crinoid stems sperifer, athyris and schuchertella fragments.  
 5990-6000 Limestone, light brownish gray 5YR6/1 to N6, dense to saccharoidal  
 to slightly fragmental; tight.  
 6000-6020 Limestone N6, dense to fine crystalline.  
 6020-6030 Limestone N6, to light brownish gray 5YR6/1, dense to finely  
 crystalline.  
 6030-6040 Limestone ditto some fragments.  
 6040-6050 Limestone; slightly fragmental N6-7, slightly, fragmental.  
 6050-6060 Limestone N6, finely fragmental; some dark gray stain.  
 6060-6070 Limestone N8, dense to slightly fragmental.  
 6070-6080 Limestone N5, dense.  
 6080-6090 Limestone, ditto.  
 6090-6100 Limestone slightly, fragmental N6 to 5YR6/1, gray, N6 and white  
 chert brachiopod fragmental and producted spines.  
 6100-6110 Limestone N6 dense, to slightly fragmental, brachiopod fragmental,  
 gray and white chert.  
 6110-6120 Limestone dense N5 to 5YR6/1.  
 6120-6130 Limestone slightly fragmental N8; producted fragmental milky white  
 chert.  
 6130-6140 Limestone N7 dense, producted spines.  
 6140-6150 Limestone N6 dense; brachiopod fragmental; milky white chert.  
 6150-6160 Limestone, ditto, dense to finely crystalline; ostracod.  
 6160-6170 Limestone, dense to fragmental, N6 to 5YR6/1.  
 6170-6180 Limestone ditto 5YR6/1.  
 6180-6190 Limestone ditto, ostracod; very dirty sample.  
 6190-6200 Limestone ditto N5; very dirty sample.  
 6200-6210 Limestone N6 dense to saccharoidal; crinoid stem; white chert.  
 6210-6220 Limestone N7 ditto, brachiopod fragmental.  
 6220-6230 Limestone ditto.  
 6230-6240 Limestone N6, dense; chert N6.  
 6240-6250 Limestone as above.  
 6250-6260 Limestone dense N7 to N6; some pyrite.  
 6260-6270 Limestone dense; N5.  
 6270-6280 Limestone dense, N6; much disseminated pyrite.  
 6280-6290 Limestone dense N6.  
 6290-6300 Limestone dense; N5, brachiopod fragment.  
 6300-6310 Limestone dense, medium gray N5.  
 6310-6320 Limestone dense to slightly fragmental N5; brachiopod fragmental.  
 6320-6330 Limestone, light brownish gray 5YR6/1; dense to slightly  
 fragmental.  
 6330-6340 Limestone N6, dense; chert, milky white.  
 6340-6360 Limestone 5YR6/1, dense to fine saccharoidal.  
 6360-6370 Limestone pinkish gray 5YR8/1 and N8.  
 6370-6380 Shale medium dark gray N4; much limestone as above; Electro log  
 would put this at 6350.



6380-6390 Shale as above; sandstone fine grained N6; large frosted quartz grain.

6390-6400 Sandstone, very fine grained N8, shale grayish red purple 5R4/2 very rare.

6400-6410 Shale grayish black N2; coarse, rounded, frosted sand grains; sandstone as above; shale, grayish red 10R4/2.

6410-6420 Shale dark gray N3, fissile, carbonaceous.

6420-6430 Dolomite moderate orange pink 10R7/4, earthy, dense.

6430-6440 Shale N4 probably not in place.

6440-6450 Dolomite 10R7/4 nearest color 1, lots of shale as above.  
Core #25 6452-6462 Recovery 5".  
4 1/2" Anhydrite, brownish, crystalline, hard.  
1/2" Dolomite, dark brown, dense.

6150-6460 Limestone dolomitic, pinkish gray 5YR8/1, dense to slightly saccharoidal; some pyrite anhydrite.

6460-6470 Limestone light brownish gray, 5YR6/1, dense to slightly saccharoidal. Dark specks on limestone.

6470-6480 Limestone 5YR6/1 coarse to medium saccharoidal.

6480-6490 Limestone ditto some vugular porosity crinoid stem.

6490-6500 Limestone, pinkish gray 5YR8/1; saccharoidal to coarse fragments.

6500-6510 Limestone ditto, dark stain.

6510-6520 Limestone 5YR8/1, more saccharoidal than fragmental.

6520-6530 Limestone light brownish gray 5YR6/1, dense, dark stained, looks more like U.D. stuff above looks Manitoban.

6530-6540 Limestone ditto.

6540-6550 Limestone ditto dolomitic with black stain; limestone pinkish gray 5YR8/1 with saccharoidal texture and vugular porosity; shale, medium dark gray (N4).

6550-6560 Dolomite 5YR6/1 saccharoidal.

6560-6570 Limestone pinkish gray 5YR8/1, fragmental - Manitoban looking.

6570-6580 Limestone ditto, slightly saccharoidal - Manitoban looking.

6580-6590 Limestone 5YR8/1, dense to slightly saccharoidal - Manitoban looking.

6590-6600 Limestone 5YR8/1 dense to fragmental - Manitoban looking.

6600-6610 Dolomite, light brownish gray 5YR6/1, saccharoidal, black stain, could be U.D. or Dw; intergranular porosity.

6610-6620 Dolomite ditto, intergranular porosity U.D. or Dw looking.

6620-6630 Limestone 5YR8/1, saccharoidal to fragmental - Manitoban looking.

6630-6640 Limestone 5YR8/1, dense, black stain.

6640-6650 Limestone N8, dense.

6650-6660 Dolomite 5YR6/1, very saccharoidal intergranular porosity; white anhydrite.

6660-6670 Dolomite ditto, vugular and intergranular porosity, some dark stain; U.D. looking or Dw.

6670-6680 Dolomite pale yellowish brown 10YR6/2, very saccharoidal very good vugular, and intergranular porosity, dark stained.

6680-6690 Dolomite ditto excellent porosity.  
Core #26 6695-6705 Recovery 5'11"  
1'5" Limestone, dark gray brown, dense to finely crystalline, dolomitic black, carbonaceous partings.  
1'11" Limestone, brown gray, finely crystalline dolomitic.  
7" Limestone, brown, dense to finely crystalline.  
4" Dolomite, tan, dense, very hard, fossil fragments (crinoids).

2'6" Limestone brown to black with dark green patches, dense to crystalline dolomitic, patches of dolomite, chocolate brown, very dense, anhydrite inclusions.

6690-6700 Dolomite ditto.

6700-6710 Limestone N6, dense, dark stain.

6710-6720 Limestone light brownish gray 5YR6/1, dense.

6720-6730 Limestone N5, dense.

Core #27 6721-6731 Recovery 4'2".

3" Dolomite, tan dense, calcareous.

1'5" Dolomite; mottled brown, dense to finely crystalline, very calcareous (top each one has numerous large rounded, frosted, gray quartz grains).

3" Dolomite, mottled green, granular, numerous grains as above.

6" Dolomite mottled brown, dense to finely crystalline, very calcareous.

7" Dolomite, brown gray, dense to finely crystalline, very calcareous.

10" Dolomite, orange tan, dense to finely crystalline, (coring sample show lost recovery at bottom; dolomite, light buff, dense to earthy).

6730-6740 Limestone 5YR6/1, dense, vugular porosity.

6740-6750 Limestone and dolomite 5YR6/1, limestone dense, dolomite saccharoidal; some black stain; some vugular porosity.

Core #28 6715-6755 Recovery 4'.

6" Limestone, buff gray, finely crystalline, dolomitic.

4" Limestone, light brown, dense, dolomitic, patches of dolomite, brown, crystalline.

7" Limestone, brown to gray, finely crystalline, dolomitic, patches anhydrite, crystalline.

6" Limestone, dark gray to black, shaly, argillaceous dolomitic.

4" Interbedded anhydrite, chocolate brown, dense to crystalline and dolomite chocolate brown, dense to finely crystalline; abundant disseminated pyrite.

2" Dolomite; chocolate brown, finely crystalline, calcareous.

4" Dolomite, tan, finely crystalline.

2" Anhydrite; dark brown, dense.

2" Anhydrite; dark brown, dense.

11" Dolomite, tan dense, calcareous (coring samples show lost recovery at bottom limestone, buff to white, granular to dense).

6750-6760 Limestone, pinkish gray 5YR8/1, dense, fossiliferous; Dolomite 5YR6/1, saccharoidal, vugular & intergranular porosity.

6760-6770 Limestone 5YR8/1 dense.

Core #29 6765-6775 Recovery 3'6".

6" Limestone, light gray, granular to finely crystalline, dolomitic.

8" Limestone, brown gray, finely crystalline, dolomitic, included large brown dolomite crystals.

1'2" Limestone, light gray, granular to finely crystalline.

1' Limestone, buff gray, finely crystalline, dolomitic.

2" Dolomite, dark brown to black, dense to finely crystalline. (lost recovery in center of core; dolomite, buff, granular, soft, gypsiferous).

6770-6780 Limestone pinkish gray 5YR8/1, finely saccharoidal.

6780-6800 Dolomite 5YR8/1, very finely saccharoidal.

6800-6810 Dolomite light brownish gray 5YR6/1, finely saccharoidal.  
 6810-6820 Dolomite as above; limestone 5YR6/1 dense; some of dolomite is dark stained.  
 6820-6830 Dolomite pinkish gray 5YR8/1, finely saccharoidal; limestone as above.  
 6830-6850 Limestone 5YR6/1, dense; dolomite as above.  
 6850-6860 Limestone N5 medium gray, dense.  
 6860-6870 Limestone brownish gray 5YR4/1, dark stained.  
 Core #30 6869-6879 Recovery 5'3".  
 6" Limestone, dark red and green (mottled), very dense, argillaceous.  
 8" Limestone, dark gray, very dense, argillaceous.  
 9" Limestone, dark brown, very dense, argillaceous, dolomitic.  
 1' Limestone, black, very dense, argillaceous dolomite.  
 4" Limestone, gray green, very dense, argillaceous; abundant ostracods, inclusions of very black waxy-looking material (coring sample and time shows recovery lost at bottom; limestone, light brown, dense, dolomitic).  
 6870-6880 Limestone 5YR6/1, dense with moderate reddish orange mottles 10R6/6.  
 6880-6890 Limestone ditto no mottles.  
 6890-6900 Limestone pinkish gray 5YR8/1, dense, very light color notable, looks like Sil Stonewall of Manitoba, very pure limestone.  
 6900-6910 Limestone ditto.  
 6910-6920 Limestone ditto, some faint pinkish mottles.  
 6920-6930 Limestone ditto, some disseminated pyrite.  
 6930-6940 Limestone 5YR6/1, dense, darker than above, dolomitic (?)  
 6940-6950 Limestone ditto, dirty sample.  
 6950-6970 Limestone N5 medium gray, dense.  
 6970-6980 Limestone dense, closest to pale brown 5YR5/2.  
 6980-6990 Limestone dense N6.  
 6990-7000 Limestone dense, 5YR6/1, some black stain.  
 7000-7010 Limestone ditto, 5YR6/1 to 5YR8/1.  
 7010-7020 Limestone dense 5YR8/1.  
 7020-7030 Sandstone very fine grain, pale red 5R6/2 and light gray N7 much limestone as above.  
 7030-7040 Sandstone, large frosted grains in matrix of very fine grained sandstone, white N9; much limestone as above.  
 7040-7050 Sandstone fine grained, N8.  
 7050-7060 Limestone dense to slightly fragmental 5R6/1; sandstone as above.  
 7060-7070 Limestone dense 5YR6/1 sandstone as above.  
 7070-7080 Limestone ditto, dolomitic; much sandstone as above.  
 7080-7090 Dolomite, dense to slightly saccharoidal, pinkish gray 5YR8/1, vugular porosity.  
 7090-7100 Dolomite ditto, fair vugular porosity.  
 7100-7110 Dolomite, medium saccharoidal, 5YR8/1, small amounts of inter-granular porosity.  
 7110-7120 Shale light greenish gray 5GY8/1 with maroon specks; dolomite as above.  
 7120-7130 Shale, light gray N7, slightly calcareous.  
 7130-7140 Sandstone N7 to 5YR6/1, fine to medium grained, pretty tight-looking.  
 7140-7150 Sandstone ditto with medium dark gray (N4) shale.  
 7150-7160 Dolomite light brownish gray 5YR6/1 dense to fine saccharoidal.

7160-7170 Limestone, 5YR6/1, dense to fine saccharoidal.  
 7170-7190 Dolomite 5YR8/1, dense to fine saccharoidal.  
 7190-7200 Dolomite, 5YR8/1, very pure, coarsely crystalline.  
 7200-7210 Dolomite, 5YR8/1, dense to coarsely crystalline.  
 7210-7220 Dolomite, 5YR8/1, coarsely crystalline, intergranular porosity.  
 7220-7230 Dolomite ditto excellent vugular porosity.  
 7230-7240 Dolomite ditto good intergranular porosity.  
 7240-7260 Dolomite ditto good porosity.  
 7260-7270 Dolomite ditto, fair porosity black stain, very slight fluorescence.  
 7270-7280 Dolomite ditto good porosity dead oil stain.  
 7280-7290 Dolomite ditto dense to coarsely fragmental 5YR8/1, good porosity.  
 7290-7310 Dolomite ditto, some oil stain.  
 7310-7320 Dolomite 5YR8/1 to 5YR6/1, dense to coarsely crystalline oil stain, fair porosity.  
 7320-7330 Dolomite ditto oil stain, little or no porosity.  
 7330-7340 Dolomite 5YR8/1, dense, no porosity, oil stain?  
 7340-7350 Dolomite ditto, oil stain.  
 7350-7360 Dolomite ditto, trace gray shale (N5).  
 7360-7370 Dolomite ditto, some oil stain? some vugular porosity.  
 7370-7380 Dolomite 5YR8/1, dense, some oil stain, little or no porosity.  
 7380-7390 Dolomite ditto, little vugular porosity.  
 7390-7400 Dolomite ditto, vugular porosity dense and coarsely fragmental.  
 7400-7420 Dolomite ditto, good vugular porosity.  
 7420-7430 Dolomite ditto, little or no porosity.  
 7430-7440 Dolomite ditto, vugular porosity.  
 7440-7450 Dolomite ditto, much medium dark gray (N4) shale, sample contaminated (?)  
 7450-7460 Dolomite 5YR8/1 dense, oil stain? some pale red 5R6/2 fragment of dolomite.  
 7460-7470 Dolomite ditto with 5R6/2 staining, some vugular porosity.  
 7470-7480 Dolomite ditto, sandstone pale red 10R6/2, fine grained.  
 7480-7490 Limestone light brownish gray 5YR6/1 dense.  
 7490-7500 Limestone ditto, many brachiopod fragments, bryozoa fragments.  
 7500-7510 Sandstone medium grained; some dark mineral, quartzite, very light gray (N8).  
 7510-7520 Sandstone ditto, more loosely cemented, some porosity.  
 7520-7530 Sandstone ditto, some very coarse rounded quartz grains.  
 7530-7540 Sandstone ditto, good intergranular porosity.  
 7540-7550 Sandstone ditto, limestone light brownish gray 5YR6/1, dense.  
 7550-7560 Limestone 5YR6/1, dense.  
 7560-7570 Limestone medium light gray N6, dense, fossiliferous, dark stain.  
 7570-7580 Limestone ditto.  
 7580-7590 Limestone ditto, sample badly contaminated.  
 7590-7600 Limestone ditto, some limestone brownish gray 5YR4/1, dense; much gray shale contaminated (?)  
 Core #31 7596-7606 Recovery 10'  
 7" Limestone, dark brown-gray, finely crystalline.  
 4'10" Limestone, dark gray to black, dense to finely crystalline, shaly, argillaceous, with patches of coarsely crystalline limestone, abundant bryozoa in patches; cup corals; *Platystrophia* species.  
 3" Limestone, brown, medium crystalline; bryozoa, brachiopod and cup coral fragments.

1'1" Limestone, dark gray to black, dense to finely crystalline, shaly argillaceous; abundant bryozoa brachiopod fragments.

3'3" Shale, dark green, calcareous; abundant bryozoa and brachiopod fragments Rafinesquina species.

7600-7610 Limestone medium gray N5, dense, black stain, brachiopod bryozoa fragments, some pyrite.

7610-7620 Limestone ditto fossiliferous.

7620-7630 Limestone, dense, very fossiliferous with corals and brachiopods.

7630-7640 Limestone N5, dense, brachiopods; pyrite.

7640-7650 Limestone ditto, much medium gray (N5) shale (probably cave).

7650-7660 Limestone ditto; sample very dirty.

7660-7670 Dolomite grayish orange pink 5YR7/2, dense.

7670-7680 Dolomite 5YR7/2 to very pale orange 10YR8/2, dense to fine saccharoidal.

7680-7700 Limestone dense, light brownish gray 5YR6/1.

7700-7710 Limestone, dense, light brownish gray 5YR6/1.

7710-7720 Limestone, ditto, some black stain.

7720-7730 Limestone ditto, some saccharoidal limestone present.

7730-7740 Limestone 5YR8/1 to 5YR6/1 dense to saccharoidal.

7740-7750 Limestone 5YR6/1, very dense.

7750-7760 Limestone ditto; anhydrite, white.

7760-7770 Dolomite 5YR8/1, dense to fine saccharoidal.

7770-7780 Dolomite ditto, some thin parallel bands of calcite on one fragment.

7780-7790 Dolomite ditto, some black stain.

7790-7800 Dolomite, ditto, some stain.

7800-7810 Dolomite fine saccharoidal 5YR8/1.

7810-7820 Dolomite, ditto, vugular porosity, some black stain.

7820-7830 Dolomite, nearest to grayish orange pink 5YR7/2, medium saccharoidal, much intergranular and vugular porosity, and some dark stains.

7830-7840 Dolomite ditto, some stain, good porosity.

7840-7850 Dolomite ditto, good vugular and intergranular porosity.

7850-7860 Dolomite ditto, fine intergranular porosity.

7860-7880 Limestone 5YR6/1, dense.

7880-7900 Limestone ditto, shell fragments.

7900-7910 Limestone 5YR6/1, dense.

7910-7920 Limestone 5YR8/1, dense.

7920-7950 Limestone ditto, dirty sample.

7950-7960 Limestone 5YR8/1, dense, dirty sample.

7960-7990 Limestone ditto, fossil fragments.

7990-8020 Limestone ditto, dense to slightly fragmental.

8020-8040 Limestone 5YR8/1, dense to fragmental.

8040-8050 Limestone ditto, sandstone (?) fine to medium grained calcareous. this may be saccharoidal limestone but it grinds in teeth.

8050-8060 Limestone ditto, sandstone? ditto very calcareous.

8060-8070 Limestone ditto, very fossiliferous; sandstone (?) with black stain.

8070-8080 Limestone ditto, sandstone ? more abundant, dark stain.

8080-8090 Limestone ditto, sandstone ? abundant, vugular porosity.

8090-8100 Limestone ditto, sandstone ? less abundant.

8100-8110 Limestone ditto, sandstone ? abundant.

8110-8120 Limestone ditto, many shell fragments.

8120-8130 Limestone ditto, sandstone ? abundant.

8130-8160 Limestone 5YR6/1, saccharoidal, shell fragments, sandy.  
 8160-8170 Limestone 5YR8/1, dense; much gray shale caving.  
 8170-8180 Limestone ditto, limestone 5YR8/1; saccharoidal  
 Core #32 8175-8185 Recovery 7'.  
 7' Limestone, brown, medium crystalline, dolomitic; very few  
 crinoid stems and fossil fragments.  
 Plectambonites sp., and Camarotoechia sp.  
 8180-8190 Limestone 5YR6/1 dense, slightly fragmental.  
 8190-8200 Limestone ditto, some disseminated pyrite.  
 8200-8210 Limestone ditto, some questionable black stain.  
 8210-8220 Limestone ditto, fossil fragmental.  
 8220-8250 Limestone ditto, some disseminated pyrite.  
 8250-8270 Limestone 5YR6/1, dense to slightly fragmental no pyrite.  
 8270-8280 Limestone ditto, many fossil fragments.  
 8280-8310 Limestone ditto fossil fragments.  
 8310-8320 Limestone ditto, shale greenish gray 5G6/1.  
 8320-8330 Limestone and shale ditto, more shale.  
 8330-8340 Shale greenish gray, 5GY6/1.  
 8340-8350 Shale N5, limestone as above.  
 8350-8360 Shale N6, splintery.  
 8360-8370 Shale dark greenish gray 5GY4/1.  
 8370-8380 Shale ditto, some pyrite, greasy looking, splintery.  
 8380-8420 Shale ditto brachiopod ? fragment.  
 8420-8430 Shale ditto, some shale brownish gray 5YR4/1, splintery.  
 8430-8450 Shale ditto for both colors.  
 8450-8490 Shale 5GY4/1 and 5YR4/1, splintery, greasy looking.  
 8480-8490 Core #33 8481-8486 Recovery 3'.  
 1" Sand, gray to white, very coarse, subround, porous.  
 1'6" mixture of sand, clear and frosted, very coarse, slightly  
 conglomeric subround and dolomite, greenish, very  
 argillaceous, shaly (not interbedded); black phosphated (?)  
 pellets.  
 7" Sand, gray, coarse, subangular, hard, tight.  
 4" Sand, green very coarse, slightly conglomeric, dolomitic,  
 hard, black phosphate (?) pellets.  
 6" Sand, green, fine to coarse, soft, shaly.  
 Core #34 8486-8491 Recovery 5'.  
 5' Sand, white medium and coarse, subround, soft, fair to good  
 porosity and permeability slight sulfur taste (coring sample,  
 shale green).  
 8490-8500 Shale ditto.  
 8500-8510 Shale ditto, large angular to subangular quartz grains. Quartz  
 crystals secondarily enlarged (?)  
 8510-8520 Shale ditto, sandstone, medium grained (N6) and some large quartz  
 grains.  
 8520-8530 Shale and sandstone as above.  
 8530-8540 Shale 5GY4/1 to 5G4/1, splintery; sandstone medium grained N6;  
 large quartz grains.  
 8540-8550 Shale ditto, little sandstone.  
 8550-8560 Shale and sandstone as above about 50-50. So is quite well  
 cemented.  
 8560-8570 Shale and sandstone as above.  
 8570-8580 Shale as above; limestone white dense.  
 8580-8590 Shale and limestone as above; limestone has shell fragments.

8590-8600 Shale with very little limestone.  
 8600-8610 Shale with limestone as above which has included glauconitic and shell fragment.  
 8610-8620 Shale and glauconitic limestone as above.  
 8620-8630 Shale as above, sandstone, slightly conglomeratic, limestone as above.  
 8630-8640 Shale, sandstone, limestone as above in about equal part.  
 8640-8650 Shale sandstone and limestone, Limestone is glauconitic.  
 8650-8670 Shale and sandstone, glauconitic about 50-50.  
 8670-8680 Shale and sandstone as above; large rounded frosted quartz grains.  
 8680-8700 Shale as above; small amounts of sandstone as above; some large quartz grains as above.  
 8700-8710 Shale and little sandstone as above.  
 8710-8730 Shale and sandstone as above.  
 8730-8740 Shale as above, very little sandstone.  
 8740-8750 Shale and sandstone 50-50 little porosity in sandstone.  
 8750-8760 Shale and sandstone about 50-50.  
 8760-8770 Shale and sandstone about 50-50; sandstone has dark mineral.  
 8770-8780 Shale as above; limestone white, dense, some sandstone.  
 8780-8790 Shale and sandstone as above about 75-25; sandstone is glauconitic.  
 8790-8800 Shale and sandstone as above; some limestone as above.  
 8800-8810 Shale and sandstone as above; some limestone with rusty oolitic looking particles.  
 8810-8820 Shale and sandstone as above about 50-50; limestone is very glauconitic.  
 8820-8830 Shale and sandstone and limestone as above; limestone in minority.  
 8830-8840 Shale and sandstone as above about 50-50; large frosted rounded quartz grains.  
 8840-8850 Amphibolite - Prof.  
     Core #35 8845-8848 Recovery 6"  
     6" Amphibolite (Chlonte and Hornblende; trace of pyrite)  
     Core #36 8848-8850 Recovery 2'  
     1' Amphibolite; masses of a dark red iron mineral and crystalline white feldspar.  
     1' Amphibolite.  
 8850 Total Depth.