

NORTH DAKOTA GEOLOGICAL SURVEY CIRCULAR NO. 33

Summary of the Emma Kleven No. 1 Well
Burleigh County, North Dakota

By John W. Caldwell
November 28, 1953

Hunt Oil Company-Emma Kleven No. 1, Burleigh County, North Dakota, Section 18, T. 140N., R. 80W., (325 feet E. of W. line and 660 feet N. of S. line, Section 18). Elevation G.L. 1910, total depth 8115.

The Hunt #1 Kleven was spudded September 20, 1952, and 10 3/4 inch casing was run at 708 feet, cemented with 450 sacks. The well was plugged November 16, 1952.

Cement plugs were set at the following depths and in the following formations.

| <u>Formation</u> | <u>Depth</u> |
|--------------------------|--------------------------|
| Red River | 7464-7550 with 30 sacks |
| Devonian | 5857-5900 with 15 sacks |
| Mississippian | 4903-4960 with 20 sacks |
| Dakota | 2993-3050 with 20 sacks |
| Greenhorn | 2480-2538 with 20 sacks |
| Bottom of Surface Casing | 650- 713 with 30 sacks |
| Surface Plug | Ground- 31 with 15 sacks |

Cores

The well was cored from 5048 to 5101 and recovered 23 feet of anhydrite and 30 feet of limestone, with no indication of oil shows.

Tests

DST 7729-63: Tool open 3 hours, shut in 30 minutes. Good blow 25 minutes, died, covered 315 feet slightly oil cut mud, 7185 feet salt water. F.P. 3700#, S.I.P. 3700#, H.P. 4500#.

Water analysis from DST 7729-63:

Analysis from Top of Test

| Constituents | PPM |
|-------------------------|--------|
| Sodium | 8,046 |
| Calcium | 1,558 |
| Magnesium | 175 |
| Sulfate | 2,872 |
| Chloride | 12,800 |
| Bicarbonate | 1,295 |
| Observed pH | 7.9 |
| Res @ 68° F. ohms/meter | 0.29 |
| Calculated total solids | 26,089 |

Analysis from Middle of Test

| | |
|-------------------------|---------|
| Constituents | PPM |
| Sodium | 51,666 |
| Calcium | 2,859 |
| Magnesium | 489 |
| Sulphate | 2,789 |
| Chloride | 84,000 |
| Bicarbonate | 135 |
| Observed pH | 7.4 |
| Res @ 68° F. ohms/meter | 0.07 |
| Calculated total solids | 141,878 |

Analysis from Bottom of Test

| | |
|-------------------------|---------|
| Constituents | PPM |
| Sodium | 52,358 |
| Calcium | 2,801 |
| Magnesium | 485 |
| Sulphate | 2,757 |
| Chloride | 85,000 |
| Bicarbonate | 105 |
| Observed pH | 6.9 |
| Res @ 68° F. ohms/meter | 0.07 |
| Calculated total solids | 143,453 |

Formation tops determined from sample and electric logs, not all lithologic formation tops called in following list. Colors determined from rock color chart.

FORMATION TOPS

| <u>System and Formation</u> | <u>Tops</u> |
|-----------------------------|--------------|
| Cretaceous | <u>Depth</u> |
| Niobrara | 2020 |
| Greenhorn | 2481 |
| Muddy | 2900 |
| Dakota | 3125 |
| Jurassic | |
| Morrison | 3360 |
| Sundance | 3380 |
| Piper | 3841 |
| Triassic | |
| Spearfish | 3987 |
| Mississippian | |
| Amsden | 4032 |
| Big Snowy | 4234 |
| Charles | 4533 |
| Mission Canyon | 4912 |
| Lodgepole | 5211 |
| Englewood | 5811 |
| Devonian | |
| Three Forks | 5830 |
| Nisku | 5850 |

| <u>System and Formation</u> | <u>Tops</u> |
|-----------------------------|-------------|
| Duperow | 5909 |
| Souris River | 6133 |
| Dawson Bay | 6260 |
| Elk Point | 6372 |
| Ashern | 6418 |
| Silurian | |
| Interlake | 6431 |
| Ordovician | |
| Upper Stony Mountain | 6700 |
| Stony Mountain Shale | 6798 |
| Red River | 6896 |
| Winnipeg Formation | |
| Winnipeg Shale | 7561 |
| Winnipeg Sand | 7725 |

Hunt #1 Kleven
 Sec. 18-14ON-80W C SW SW
 Burleigh Co. N. D.

| <u>From</u> | <u>To</u> | <u>Formation</u> |
|-------------|-----------|---|
| 710 | 720 | Shale, medium light gray, silty. |
| 720 | 750 | Shale, medium light gray, silty, lumpy. |
| 750 | 790 | Shale, medium light gray, slightly bentonitic. |
| 790 | 800 | Shale, dark yellow brown, very silty with very fine sand. |
| 800 | 830 | Shale, medium light gray, silty with very fine sand. |
| 830 | 840 | Shale, medium dark gray, lignitic micaceous. |
| 840 | 870 | Shale, medium gray, bentonitic, few carbonaceous remains. |
| 870 | 880 | Shale, medium gray, bentonitic. |
| 880 | 890 | Shale, medium dark gray, bentonitic, silty. |
| 890 | 930 | Shale, medium gray, bentonitic. |
| 930 | 970 | Shale, medium gray, slight bentonitic. |
| 970 | 980 | Shale, medium gray, slightly bentonitic, little pale reddish brown shale, micaceous, sandy. |
| 980 | 1000 | Shale, medium gray, plant fragments replaced with pyrite. |
| 1000 | 1010 | Shale, medium dark gray, plant fragments replaced with pyrite. |
| 1010 | 1020 | Shale, olive gray, slightly bentonitic. |
| 1020 | 1030 | Shale, medium gray, slightly bentonitic, calcareous. |
| 1030 | 1050 | Shale, medium gray, bentonitic, calcareous. |
| 1050 | 1060 | Shale, medium gray, slightly bentonitic. |
| 1060 | 1070 | Shale, medium gray, slightly bentonitic, calcareous. |
| 1070 | 1090 | Shale, medium gray to light olive gray, slightly bentonitic, slight calcareous. |
| 1090 | 1110 | Shale, medium gray, slightly bentonitic, slight calcareous, pyrite. |
| 1110 | 1130 | Shale, medium gray, calcareous. |
| 1130 | 1140 | Shale, medium gray, bentonitic, calcareous. |
| 1140 | 1150 | Shale, medium gray, slightly bentonitic, slight calcareous. |
| 1150 | 1160 | Shale, medium gray, slightly bentonitic. |
| 1160 | 1180 | Shale, medium light gray, compact. |

| <u>From</u> | <u>To</u> | <u>Formation</u> |
|-------------|-----------|--|
| 1180 | 1200 | Missing. |
| 1200 | 1250 | Shale, medium light gray, compact. |
| 1250 | 1280 | Shale, medium gray, dense, compact. |
| 1280 | 1290 | Shale, medium gray, soft, lumpy, slight calcareous, slightly bentonitic. |
| 1290 | 1320 | Shale, medium light gray, dense, compact. |
| 1320 | 1340 | Shale, medium gray, soft, lumpy, slight calcareous, slightly bentonitic. Shale as above. |
| 1340 | 1450 | Shale, medium light gray, dense, compact. |
| 1450 | 1470 | Shale, medium gray, soft, lumpy, slight calcareous, slightly bentonitic. Shale as above. |
| 1470 | 1530 | Shale, medium light gray, dense, compact. |
| 1530 | 1550 | Shale, medium light gray, soft, lumpy, slight calcareous, slightly bentonitic. |
| 1550 | 1600 | Shale, medium light gray, soft, lumpy, slight bentonitic. |
| 1600 | 1640 | Shale, medium light gray, soft, lumpy, slight calcareous, slightly bentonitic, inoceramus. |
| 1640 | 1660 | Shale, medium gray, soft, lumpy, bentonitic. |
| 1660 | 1670 | Shale, medium gray, slightly bentonitic, sandy, soft, lumpy. |
| 1670 | 1680 | Shale, medium gray, bentonitic sandy, soft, lumpy. |
| 1680 | 1760 | Shale, medium gray, bentonitic calcareous, soft, lumpy. |
| 1760 | 1800 | Shale, medium gray, large amount bentonitic, calcareous, soft, lumpy. |
| 1800 | 1820 | Shale, medium gray, bentonitic, calcareous, few carbonaceous remains. |
| 1820 | 1880 | Shale, medium gray, bentonitic, calcareous. |
| 1880 | 1920 | Shale, medium gray, bentonitic, calcareous, shell fragments. |
| 1920 | 1990 | Shale, medium gray, bentonitic, calcareous, shell fragments. |
| 1990 | 2000 | Shale, dark gray. |
| 2010 | 2020 | Shale, dark gray, some medium gray shale, bentonitic and calcareous. |
| 2020 | 2040 | Shale, dark gray, lignitic, little medium gray shale. |
| 2040 | 2050 | Shale, medium gray, bentonitic, calcareous, little dark gray shale as above. |
| 2050 | 2100 | Shale, medium gray, bentonitic, calcareous. |
| 2100 | 2120 | Shale, medium dark gray, calcareous bentonitic. |
| 2120 | 2150 | Shale, medium gray, bentonitic, calcareous. |
| 2150 | 2170 | Shale, medium dark gray, bentonitic, calcareous. |
| 2170 | 2220 | Shale, medium gray, bentonitic, calcareous. |
| 2220 | 2280 | Shale, medium gray, slightly bentonitic, calcareous. |
| 2280 | 2300 | Shale, medium gray, bentonitic, calcareous. |
| 2300 | 2350 | Shale, medium gray, slightly bentonitic, calcareous. |
| 2350 | 2380 | Shale, medium dark gray, slightly bentonitic, calcareous. |
| 2380 | 2390 | Shale, medium gray, bentonitic, calcareous. |
| 2390 | 2410 | Shale, medium gray, calcareous, slightly bentonitic. |
| 2410 | 2420 | Shale, medium dark gray, calcareous, slightly bentonitic. |
| 2420 | 2430 | Shale, medium gray, calcareous, bentonitic. |
| 2430 | 2460 | Shale medium dark gray, calcareous, bentonitic. |
| 2460 | 2500 | Shale, medium gray, calcareous, bentonitic. |
| 2500 | 2510 | Shale, medium gray, bentonitic, calcareous, large amount shell fragments. |

| <u>From</u> | <u>To</u> | <u>Formation</u> |
|-------------|-----------|---|
| 2510 | 2520 | Shale, medium dark gray, slightly bentonitic, calcareous, large amount shell fragments. |
| 2520 | 2530 | Shale, dark gray, calcareous, some shell fragments. |
| 2530 | 2550 | Shale, dark gray, calcareous, some shell fragments, white specks. |
| 2550 | 2570 | Shale, medium gray, calcareous, large amount of shell fragments. |
| 2570 | 2600 | Shale, medium dark gray, some limestone, some shell fragments. |
| 2600 | 2620 | Shale, dark gray, some shell fragments, lignitic. |
| 2620 | 2640 | Shale, medium dark gray, few shell fragments, pyrite. |
| 2640 | 2660 | Shale, medium dark gray, few shell fragments. |
| 2660 | 2680 | Shale, medium gray, calcareous, bentonitic. |
| 2680 | 2690 | Shale, medium dark gray, calcareous slightly bentonitic. |
| 2690 | 2700 | Shale, dark gray, lignitic in part. |
| 2700 | 2720 | Shale, medium dark gray, calcareous, slightly bentonitic. |
| 2720 | 2770 | Shale, dark gray, lignitic. |
| 2770 | 2790 | Shale, dark gray, lignitic, pyrite. |
| 2790 | 2810 | Shale, medium dark gray. |
| 2810 | 2840 | Shale, dark gray, micaceous, pyrite. |
| 2840 | 2860 | Shale, medium dark gray, bentonitic. |
| 2860 | 2880 | Shale, medium dark gray, calcareous slightly bentonitic. |
| 2880 | 2890 | Shale, medium dark gray, slightly calcareous. |
| 2890 | 2910 | Shale, medium dark gray. |
| 2910 | 2950 | Shale, medium dark gray, slight calcareous slightly bentonitic. |
| 2950 | 2990 | Shale, dark gray, lignitic. |
| 2990 | 3050 | Shale, medium dark gray, slight calcareous, lignitic in part. |
| 3050 | 3080 | Shale, medium dark gray, lignitic in part. |
| 3080 | 3100 | Shale, medium dark gray. |
| 3100 | 3130 | Shale, medium dark gray, slightly calcareous. |
| 3130 | 3150 | Missing. |
| 3150 | 3170 | Shale, medium dark gray, little white fine grained sand calcareous cement. |
| 3170 | 3190 | Shale, medium dark gray, some coarse angular to rounded quartz grains. |
| 3190 | 3220 | Sandstone, loose coarse grained, rounded, frosted, large amount shale as above, porous. |
| 3217 | | Circulation 15 minutes. Sandstone, loose coarse, grained, angular to subrounded, frosted, porous. |
| 3217 | | Circulation 30 minutes. Sandstone as above, porous. |
| 3217 | | Circulation 45 minutes. Sandstone as above, some medium, dark gray shale, porous. |
| 3217 | | Circulation 60 minutes. Sandstone as above, little medium dark gray shale. |
| 3217 | | Circulation 1 1/4 hours. Shale, medium dark gray, some sand as above. |
| 3217 | | Circulation 1 1/2 hours. Shale, medium, dark gray, little sand as above. |
| 3220 | 3240 | Sandstone, loose coarse grained, angular to subrounded frosted, some shale as above, porous. |

| <u>From</u> | <u>To</u> | <u>Formation</u> |
|-------------|-----------|---|
| 3240 | 3250 | Shale, medium dark gray, some sand as above, porous. |
| 3250 | 3280 | Shale, medium dark gray, lignitic in part, little sandy as above. |
| 3284 | | Circulation. Shale, as above, little sand as before. |
| 3280 | 3300 | Shale, medium dark gray, lignitic in part, little fine, medium grained sand. |
| 3300 | 3310 | Sandstone, loose, medium-coarse grained, angular to subrounded, some shale as above, porous. |
| 3310 | 3330 | Sandstone, loose, medium-coarse grained, angular, to subrounded, little shale as above, porous. |
| 3330 | 3400 | Shale, medium dark gray, little sand as before. |
| 3400 | 3420 | Shale, medium dark gray, bentonitic, calcareous, little pyrite cemented sand. |
| 3420 | 3430 | Shale, medium dark gray, slightly bentonitic, calcareous. |
| 3430 | 3450 | Shale, medium gray, slightly bentonitic, calcareous. |
| 3450 | 3480 | Shale, medium light gray, calcareous, slightly bentonitic, silty. |
| 3480 | 3510 | Shale, medium light gray, calcareous, slightly bentonitic, some, gray-red brown siltstone calcareous cement. |
| 3510 | 3530 | Shale, medium light gray, calcareous, slightly bentonitic, little gray-red brown siltstone, calcareous cement. |
| 3530 | 3580 | Shale, medium light gray calcareous, slightly bentonitic, some white-red brown very fine grained sandstone, silty. |
| 3580 | 3610 | Shale, medium gray, calcareous, slightly bentonitic, some gray to white, very fine-fine grained sandstone silty, slight porous. |
| 3610 | 3650 | Shale, medium light gray calcareous, some white-gray, very fine-fine grained sandstone, silty, slight porous. |
| 3650 | 3670 | Shale, medium gray calcareous, little white-gray, very fine-fine grained sandstone, silty. |
| 3670 | 3680 | Shale, medium gray calcareous, numerous shell fragments. |
| 3680 | 3690 | Shale, medium gray, calcareous, slightly bentonitic. |
| 3690 | 3700 | Shale, medium gray and red-brown, calcareous, slightly bentonitic. |
| 3700 | 3720 | Missing. |
| 3720 | 3760 | Shale, medium gray calcareous, slightly bentonitic, little red-brown shale, shell fragments. |
| 3760 | 3770 | Missing. |
| 3770 | 3780 | Shale red-brown and gray, calcareous, little sugary white anhydrite. |
| 3780 | 3800 | Shale, red-brown and gray, calcareous, some white-pale yellow subcrystalline limestone, little white sugary anhydrite. |
| 3800 | 3830 | Shale, medium dark gray, some white to pale yellow limestone subcrystalline. |
| 3830 | 3850 | Shale, medium dark gray, some white to red-brown subcrystalline limestone. |
| 3850 | 3860 | Shale, medium dark gray, large amount white to pale yellow subcrystalline limestone. |
| 3860 | 3870 | Limestone, very light gray to yellowish gray subcrystalline limestone, some shale as above. |

| <u>From</u> | <u>To</u> | <u>Formation</u> |
|-------------|-----------|--|
| 3870 | 3890 | Limestone, as above, medium dark gray shale, red-brown, very calcareous shale. |
| 3890 | 3920 | Limestone, very light gray to yellowish gray subcrystalline, some medium gray shale. |
| 3920 | 3930 | Shale, medium light gray, little limestone as above, little white, subcrystalline dolomite. |
| 3930 | 3960 | Shale, medium dark gray, red-brown shale, white sugary anhydrite, little limestone and dolomite. |
| 3960 | 4050 | Shale, medium light gray, calcareous, some red-brown shale, little anhydrite. |
| 4050 | 4070 | Shale, medium light gray, calcareous red-brown shale, little white, pale red fine grained sandstone, slightly porous. |
| 4067 | | Circulation 15 minutes. Sandstone, white-pale red fine grained, some red-brown and gray shale, porous. |
| 4070 | 4090 | Shale, medium light gray, red-brown shale, pale red sandstone, pinkish gray dolomite. |
| 4090 | 4120 | Shale, medium light gray, red-brown shale, some pinkish gray dolomite, pale red sandstone. |
| 4120 | 4180 | Shale, red-brown and gray, large amount white to pale red fine grained sandstone. |
| 4180 | 4210 | Shale, red-brown, olive-gray and medium gray, little light gray limestone. |
| 4210 | 4220 | Dolomite, yellow-gray fine grained, some shale as above, some white sugary anhydrite. |
| 4220 | 4230 | Dolomite, as above, large amount medium dark gray shale, some anhydrite. |
| 4230 | 4250 | Shale, medium dark gray shale, little dolomite as above and little anhydrite. |
| 4250 | 4270 | Shale, medium dark gray, little red-brown shale, small amounts of bentonitic and anhydrite. |
| 4270 | 4290 | Shale, medium dark gray, small amount of red-brown shale, anhydrite, and dolomite. |
| 4290 | 4310 | Shale, medium gray, some white sugary anhydrite, small amounts of red-brown shale and dolomite. |
| 4310 | 4320 | Dolomite, very light gray to yellow-gray fine grained, little red-brown and gray shale. |
| 4320 | 4330 | Missing. |
| 4330 | 4350 | Shale, medium light gray, little yellow-brown and red-brown shale, little dolomite as before. |
| 4350 | 4360 | Shale, medium light gray, little yellow-brown and red-brown shale, little anhydrite. |
| 4360 | 4380 | Dolomite, yellow-gray to light olive gray fine grained, little red-brown and gray shale. |
| 4380 | 4410 | Shale, red-brown and gray, splintery, little dolomite as above. |
| 4410 | 4440 | Shale, medium gray, small amounts of yellow-brown and red-brown shale, little gypsum, anhydrite, and bentonite. |
| 4440 | 4450 | Shale, medium dark gray, small amounts of yellow-brown and red-brown shale. |
| 4450 | 4460 | Shale, medium dark gray, small amounts of yellow-brown and red-brown shale, little fine-medium grained, loose sandstone. |

| <u>From</u> | <u>To</u> | <u>Formation</u> |
|-------------|-----------|--|
| 4460 | 4480 | Shale, medium dark gray and red-brown, little yellow-brown shale. |
| 4480 | 4520 | Shale, medium dark gray, little red-brown and yellow-brown shale. |
| 4520 | 4530 | Shale, red-brown, calcareous, little gray shale and anhydrite. |
| 4530 | 4540 | Shale, medium dark gray, some red-brown calcareous shale, little dolomite. |
| 4540 | 4550 | Dolomite, light olive gray fine grained, some medium gray shale. |
| 4550 | 4560 | Limestone, light gray to light olive gray, fine grained, little gray shale. |
| 4560 | 4580 | Limestone, light gray to light olive-gray, fine grained, some red-brown and gray shale. |
| 4580 | 4590 | Limestone, as above, few ostracods, large amount of red-brown and gray shale. |
| 4590 | 4620 | Shale, medium dark gray, some red-brown shale, little limestone as above. |
| 4620 | 4660 | Limestone, very light gray to light olive-gray, fine-medium grained, little red-brown and gray shale. |
| 4660 | 4670 | Limestone, very light gray to light olive-gray, subcrystalline to fine grained, little red-brown and gray shale. |
| 4670 | 4680 | Shale, medium gray, some limestone as above, little red-brown shale. |
| 4680 | 4700 | Limestone, very light gray to light olive-gray, fine to medium grained, little gray shale. |
| 4700 | 4720 | Dolomite, light gray fine grained, some medium gray shale, little limestone as above, little anhydrite. |
| 4720 | 4730 | Shale, medium dark gray, some dolomite as above. |
| 4730 | 4740 | Shale, medium dark gray, some limestone light gray subcrystalline, little light gray dolomite subcrystalline. |
| 4740 | 4760 | Limestone, light gray to olive gray fine to coarse grained, ostracods, little gray shale, little anhydrite. |
| 4760 | 4770 | Limestone, as above, some anhydrite, little gray shale. |
| 4770 | 4790 | Dolomite, light gray fine grained, little gray shale, little anhydrite. |
| 4790 | 4800 | Dolomite, as above, large amount of gray shale. |
| 4800 | 4810 | Dolomite, as above, little gray shale, little anhydrite, little limestone. |
| 4810 | 4820 | Limestone, very light gray to yellow gray fine to medium gray, little gray shale. |
| 4820 | | Circulation 15 minutes. Limestone, very light gray to yellow-gray fine to medium gray, small amount of gray shale. |
| 4820 | | Circulation 30 minutes. Limestone, as above, little gray shale. |
| 4820 | | Circulation 45 minutes. Limestone, as above, little gray shale. |
| 4820 | 4830 | Limestone, very light gray to yellow-gray fine to medium grained, small amount of gray shale. |
| 4830 | 4840 | Limestone, as above, large amount of gray shale. |

| <u>From</u> | <u>To</u> | <u>Formation</u> |
|-------------|-----------|---|
| 4840 | 4860 | Shale, medium gray, some light gray dolomite, little limestone as above. |
| 4860 | 4880 | Shale, red-brown and gray, some dolomite and limestone. |
| 4880 | 4890 | Dolomite, light gray fine grained, some limestone, little gray shale. |
| 4890 | 4910 | Dolomite, light gray fine grained, little gray shale. |
| 4910 | 4920 | Dolomite, light gray fine grained, some limestone, little gray shale. |
| 4920 | 4940 | Limestone, very light gray to yellow-gray, fine to medium gray, little dolomite as above. |
| 4940 | 4980 | Limestone, very light gray to yellow-gray, fine to coarse grained, few oolites. |
| 4980 | 5030 | Limestone, white to yellow-gray, earthy to fine grained. |
| 5030 | 5048 | Shale, medium dark gray, little limestone as above. |
| Core | | |
| 5048 | 5050 | Anhydrite, sugary, light olive gray. |
| Core | | |
| 5050 | 5053 | Dolomite, medium light gray, dense, subcrystalline to fine grained. |
| Core | | |
| 5053 | 5056 | Anhydrite, medium light gray, fine grained. |
| Core | | |
| 5059 | 5068 | Anhydrite, medium dark gray, dolomitic, salty. |
| Core | | |
| 5068 | 5074 | Limestone, yellow-gray, medium grained, porous. |
| Core | | |
| 5074 | 5095 | Limestone, yellow-gray, medium to coarse grained, oolitic, porous. |
| Core | | |
| 5095 | 5098 | Limestone, yellow-gray, coarse grained, oolitic. |
| Core | | |
| 5098 | 5101 | Limestone, yellow-gray, fine to medium grained. |
| 5110 | 5180 | Limestone, yellow-gray, fine to medium grained, few oolites. |
| 5180 | 5200 | Limestone, yellow-gray, fine grained, little white earthy limestone. |
| 5200 | 5240 | Limestone, as above, little gray shale. |
| 5240 | 5270 | Limestone, yellow-gray, earthy to fine grain, few oolites. |
| 5270 | 5280 | Limestone, yellow-gray, fine to medium grain, oolitic. |
| 5280 | 5300 | Limestone, light gray to yellowish gray, fine to medium grain. |
| 5300 | 5320 | Limestone, as above, some gray shale. |
| 5320 | 5340 | Limestone, light gray to yellowish gray, fine to medium grain, few oolites. |
| 5340 | 5370 | Limestone, medium light gray, fine to medium grain. |
| 5370 | 5410 | Limestone, light gray, fine to medium grain, few oolites. |
| 5410 | 5420 | Limestone, as above, little gray shale. |

| <u>From</u> | <u>To</u> | <u>Formation</u> |
|-------------|-----------|---|
| 420 | 5440 | Limestone, as above, some gray shale, little red-brown shale. |
| 5440 | 5460 | Limestone, medium light gray, fine to medium grain, large amount of medium gray shale. |
| 5460 | 5490 | Limestone, as above, little gray shale. |
| 5490 | 5500 | Missing. |
| 5500 | 5530 | Limestone, light gray, earthy to medium grain. |
| 5530 | 5560 | Limestone, as above, large amount of gray shale, small amounts of red-brown and yellow-brown shale. |
| 5560 | 5580 | Shale, medium gray, some limestone as above, small amounts of red-brown and yellow-brown shale. |
| 5580 | 5600 | Limestone, medium light gray, earthy to medium grain. |
| 5600 | 5630 | Limestone, light gray, fine to medium grain. |
| 5630 | 5640 | Shale, medium dark gray cave, little limestone as above. |
| 5640 | 5660 | Limestone, medium gray, dense, fine grain, some shale as above. |
| 5660 | 5690 | Limestone, olive-gray to light gray dense, fine grain. |
| 5690 | 5720 | Limestone, as above, some gray shale. |
| 5720 | 5740 | Limestone, medium light gray to light gray, fine grain, little gray shale. |
| 5740 | 5750 | Missing. |
| 5750 | 5810 | Limestone, light gray, fine grain. |
| 5810 | 5840 | Shale, dark gray lignitic little limestone as above. |
| 5840 | 5860 | Dolomite, yellow-gray fine grain little light gray limestone. |
| 5860 | 5890 | Shale, medium gray, some dolomite and limestone as above. |
| 5890 | 5900 | Limestone, light olive-gray, saccharoidal. |
| 5900 | 5910 | Limestone, yellow-gray to light olive-gray, saccharoidal. |
| 5910 | 5960 | Limestone, yellow-gray to light olive-gray, saccharoidal. |
| 5960 | 5980 | Limestone, yellow-gray to light olive-gray, saccharoidal, little gray shale. |
| 5980 | 6020 | Limestone, yellow-gray to light olive-gray, saccharoidal, dolomitic in part. |
| 6020 | 6030 | Limestone, as above, some medium dark gray shale. |
| 6030 | 6060 | Dolomite, yellow-gray to light olive-gray, saccharoidal. |
| 6060 | 6070 | Dolomite, yellow-gray to light olive-gray, saccharoidal, some dense, fine grain limestone. |
| 6070 | 6110 | Limestone, yellow-gray, dense, fine grained. |
| 6110 | 6170 | Limestone, yellow-gray earthy to fine grained. |
| 6170 | 6230 | Limestone, as above, little medium gray shale. |
| 6230 | 6250 | Limestone, yellow-gray, fine grain, little medium gray, pale red and light tan shale. |
| 6250 | 6270 | Limestone, yellow-gray fine grain, little gray shale. |
| 6270 | 6320 | Limestone, yellow-gray to light gray, fine grain. |
| 6320 | 6350 | Limestone, white to yellowish gray, earthy to fine grain. |
| 6350 | 6360 | Limestone, light gray to yellow-gray, dense, fine grain. |
| 6360 | 6370 | Limestone, white to yellowish gray, earthy to fine grain. |
| 6370 | 6380 | Limestone, as above, little gray and greenish gray shale. |
| 6380 | 6400 | Limestone, as above, calcareous brownish gray shale and gray shale. |
| 6400 | 6420 | Shale, medium gray, little yellowish gray earthy to fine grained limestone. |

| <u>From</u> | <u>To</u> | <u>Formation</u> |
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| 6420 | 6430 | Limestone, light gray to yellow-gray earthy to fine grained, little medium gray shale. |
| 6430 | 6460 | Dolomite, yellow-gray, fine grain, little limestone as above. |
| 6460 | 6470 | Limestone, white to yellow-gray earthy to fine grain. |
| 6470 | 6500 | Limestone, grayish orange pink, fine grain, little fibrous gypsum. |
| 6500 | 6520 | Limestone, grayish orange-pink to yellow-gray, fine grain, little fibrous gypsum. |
| 6520 | 6530 | Limestone, grayish orange-pink to yellow-gray, earthy to fine grain, little gray shale. |
| 6530 | 6540 | Dolomite, white crystalline, dense, some limestone as above. |
| 6540 | 6550 | Limestone, light gray to yellowish gray, dolomitic, fine grain. |
| 6550 | 6600 | Dolomite, yellow-gray crystalline, dense. |
| 6600 | 6610 | Limestone, yellow-gray, fine grained. |
| 6610 | 6670 | Dolomite, yellow-gray dense crystalline to fine grained. |
| 6670 | 6690 | Dolomite, yellow-gray dense crystalline to fine grained, some medium light gray shale (Possibly cave). |
| 6690 | 6710 | Dolomite, yellow-gray dense crystalline to fine grained, little light brownish gray crystalline dolomite. |
| 6710 | 6720 | Dolomite, as above, some medium dark gray shale. |
| 6730 | 6740 | Dolomite, yellow-gray crystalline to fine grained, little light gray to yellow-gray limestone. |
| 6750 | 6760 | Limestone, white to yellow-gray earthy to fine grained, some yellow-gray fine grained dolomite. |
| 6760 | 6770 | Dolomite, yellow-gray fine grained. |
| 6770 | 6800 | Dolomite, yellow-gray to light olive-gray fine grained saccharoidal. |
| 6800 | 6820 | Limestone, yellow-gray crystalline to fine grained. |
| 6820 | 6830 | Limestone, as above, little gray and dark gray shale. |
| 6830 | 6850 | Limestone, light gray to medium light gray fine grained, little gray shale. |
| 6850 | 6870 | Limestone, light gray to medium light gray fine grained, little light to medium dark gray shale. |
| 6870 | 6880 | Limestone, as above, some light to medium dark gray shale. |
| 6880 | 6900 | Shale, light to medium dark gray, little limestone as above. |
| 6900 | 6910 | Circulation 30 minutes. Shale, medium dark gray little shale as above. |
| 6900 | 6910 | Shale, medium dark gray, some limestone fine-medium grained. |
| 6910 | 6930 | Dolomite, light olive-gray fine grained, little limestone as above. |
| 6930 | 6940 | Limestone, light gray to yellow-gray, fine to coarse grained oolitic in part. |
| 6940 | 6960 | Dolomite, very light gray to yellow-gray fine grained, some limestone as above. |
| 6960 | 6980 | Limestone, yellow-gray to light olive-gray dense, fine grained. |
| 6980 | 7020 | Dolomite, yellow-gray to light olive-gray fine grained. |
| 7020 | 7030 | Dolomite yellow-gray, fine grained. |
| 7030 | 7050 | Dolomite, yellow-gray fine grained, some yellow-gray earthy to fine grained limestone. |

| <u>From</u> | <u>To</u> | <u>Formation</u> |
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| 7070 | 7080 | Limestone, yellow-gray earthy to fine grained, little dolomite as above. |
| 7080 | 7090 | Shale, medium dark gray (cave?), little limestone as above. |
| 7090 | 7110 | Limestone, white to yellow-gray earthy to fine grained. |
| 7110 | 7120 | Limestone, white to yellow-gray, fine grained, few ostracods. |
| 7120 | 7130 | Limestone, white to yellow-gray fine grained. |
| 7130 | 7160 | Limestone, white to yellow-gray earthy to fine grained. |
| 7160 | 7200 | Limestone, white to yellow-gray earthy to fine grained. |
| 7270 | 7290 | Limestone, white to yellow-gray earthy to fine grained, medium dark gray shale (cave?). |
| 7290 | 7320 | Limestone, very light gray to yellow-gray, fine grained. |
| 7320 | 7370 | Missing. |
| 7370 | 7410 | Limestone, white to yellow-gray earthy to fine grained. |
| 7410 | 7430 | Limestone, white to yellow-gray earthy to fine grained, some medium dark gray shale (cave?). |
| 7430 | 7470 | Limestone, white to yellow-gray earthy to fine grained. |
| 7470 | 7480 | Limestone, white to yellow-gray fine grained. |
| 7480 | 7520 | Limestone, white to yellow-gray earthy to fine grained. |
| 7520 | 7540 | Limestone, white to yellow-gray earthy to fine grained, large amount of medium dark gray shale (cave?). |
| 7540 | 7580 | Limestone, white to yellow-gray earthy to fine grained. |
| 7580 | 7590 | Limestone, white to yellow-gray earthy to fine grained, little medium gray shale. |
| 7590 | 7610 | Shale, medium gray, some limestone as above. |
| 7610 | 7630 | Shale, dark greenish gray splintery with little olive-gray splintery shale. |
| 7630 | 7650 | Shale, olive-gray splintery with little dark greenish gray shale. |
| 7650 | 7670 | Limestone, white to yellowish gray earthy to fine grained. |
| 7670 | 7740 | Shale, dark greenish gray splintery with some olive-gray splintery shale. |
| 7740 | 7750 | Shale, as above, some fine to medium grained sandstone well rounded, frosted. |
| 7763 | | Circulation 15 minutes. Shale and sand as above. |
| 7763 | | Circulation 30 minutes. Shale and sand as above. |
| 7763 | | Circulation 45 minutes. Shale and sand as above. |
| 7763 | | Circulation 60 minutes. Shale and large amount of sand as above. |
| 7760 | 7770 | Shale, dark greenish gray splintery with some olive-gray splintery shale, some fine to medium grained sandstone well rounded, frosted. |
| 7770 | 7790 | Shale, as above, with large amount of sand as above. |
| 7790 | 7800 | Missing. |
| 7800 | 7820 | Shale, dark greenish gray and olive-gray splintery, little sandstone, fine to medium grained, little yellow-gray fine grained limestone. |
| 7820 | 7850 | Shale, dark greenish gray and olive-gray splintery, some yellow-gray fine grained limestone. |
| 7850 | 7880 | Shale, as above, little limestone as before. |
| 7880 | 7900 | Shale, as above, little fine grained sandstone slightly glauconitic. |

| <u>From</u> | <u>To</u> | <u>Formation</u> |
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| 7910 | | Circulation 1/2 hour. Shale, dark greenish gray, little glauconitic sandstone. |
| 7910 | | Circulation 1 hour. Shale, dark greenish gray splintery. |
| 7910 | | Circulation 1 1/2 hours. Shale, dark greenish gray splintery, with some olive-gray splintery shale. |
| 7930 | 7970 | Shale, as above. |
| 7970 | 7980 | Shale, dark greenish gray splintery, with some olive-gray splintery shale, little light olive-gray, fine grained sandstone. |
| 7980 | 8000 | Shale, as above, large amount of light olive-gray, fine grained sandstone. |
| 8000 | 8010 | Shale as above, little sandstone as before and a little yellow-gray, fine grained limestone. |
| 8010 | 8030 | Shale, dark greenish gray shale, some very fine to fine grained, yellow-gray to light olive-gray sandstone, little limestone, yellow-gray fine, grained. |
| 8030 | 8050 | Limestone, yellow-gray, fine grained slightly glauconitic, fine grained sandstone. |
| 8050 | 8060 | Limestone, as above, large amount of slightly glauconitic fine grained sandstone. |
| 8060 | 8080 | Sandstone, slightly glauconitic, fine grained, light olive-gray, little limestone as above, some dark greenish gray shale. |
| 8080 | 8100 | Shale, dark greenish gray splintery, little sand and limestone as before. |
| 8115 | | Total depth. |