NORTH DAKOTA GEOLOGICAL SURVEY CIRCULAR N0. 199

Summary of the Texas Company - Joseph M. Donahue No. 1
Well No. 999 - Permit No. 1011

by Dan E. Hansen
June, 1958

The Texas Company - Joseph M. Donahue No. 1, Williams County, North Dakota. Location: 1980 feet from the north line and 1975 feet from the east line of Section 23, T. 154N., R. 100W. Elevation: 2240 G.L. (Ground Level), 2253 K.B. (Kelly Bushing).

The Texas Company - Joseph M. Donahue No. 1 was spudded September 29, 1955; drilled to a total depth of 14,035 feet; found non-productive and plugged July 20, 1956.

Thirteen drill stem tests were taken, and twenty-six cores were cut. Core numbers 11 to 14 and 19 to 26 are on file at NDGS.

Electric, laterolog, microlaterolog, and radioactivity logs were run.

Logging Record:

Schlumberger electric log
- Run one, 11/14/55, - 629-6,842

Schlumberger laterlog - 7
- Run one, 1/10/56, - 6,842-9,993
- Run two, 3/6/56, - 9,993-12,319
- Run three, 6/8/56, - 12,319-14,029

Schlumherger microlaterolog
- Run one, 1/10/56, - 6,800-9,993
- Run two, 3/6/56, - 10,058-12,320

Lane wells radioactivity log
- gamma ray, 6/7/56, - surf. - 14,025
- Neutron, 6/7/56, - surf. - 14,033

Coring Record:

#1	9496-9554	#14	11,682-11,740
#2	9557-9616	#15	12,026-12,050
#3	9616-9674	#16	12,730-12,788
#4	9677-9735	#17	12,788-12,846
#5	9735-9793	#18	13,435-13,493
#6	9793-9851	#19	13,625-13,638
#7	9851-9909	#20	13,638-13,693
#8	9909-9967	#21	13,693-13,751
#9	10,002-10,060	#22	13,751-13,809
#10	10,060-10,085	#23	13,809-13,867
#11	10,984-11,042	#24	13,867-13,925
#12	11,245-11,303	#25	13,925-13,983
#13	11,511-11,549	#26	13,983-14,035

Drill Stem Tests:

DST #1 8580-8640. 2 hr. test - 30 minutes SIP. Recovered 35' drlg. mud. IFP 20# FFP 55# SIP 175#

DST #2 9460-9554. 2 hr. test - 30 minutes SIP. Recovered 100' drlg. mud. IFP 25# FFP 75# SIP 925#

DST #3 9554-9674. Mis-run, packer failed after 5 min.

DST #4 9546-9676. 3 hr. test - 30 min SIP. Recovered 195' slightly gas cut drlg. mud, 90' heavy gas cut and slightly oil cut drlg. mud. IFP 30# FFP 275# SIP 810#

DST #5 9680-9851. 2 hr. test - 30 min SIP. Recovered 158' slightly gas cut drlg. mud. IFP 0# FFP 275# SIP 375#

DST #6 9848-9967. 2 1/2 hr. test - 30 min. SIP. Recovered 120' slightly gas cut drlg. mud. IFP 25# FFP 120# SIP 120#.

DST #7 9990-10,060. 3 1/2 hr. test - 45 minutes SIP. Recovered 70' gas cut drlg. mud IFP 50# FFP 100# SIP 100#.

DST #8 10,058-10,150. 2 hr. test - 30 min. SIP. Recovered 45' drlg. mud. IFP 25# FFP 56# SIP 56#.

DST #9 10,933-11,042. 4 hr. test - 30 min. SIP. Run 1000' W.C. gas to surface 2 hrs and 50 minutes. Recovered 120' gas cut and slightly water cut drlg. mud, 880' heavily gas cut water cushion, 124' hvly. gas and mud cut water cushion with slight trace oil. IFP 480# FFP 480# SIP 1455#.

DST #10 11,235-11,303 1 1/2 hr. test - 30 min. SIP Run 1300' W.C. Recovered 1120' water cushion, 180' slightly gas and mud cut water cushion, 280' slightly gas and mud cut salt water. IFP 675# FFP 810# SIP 5175#.

DST #11 11,627-11,682. 4 hr. test - 30 min SIP. Run 1700' W.C. Recovered 45' heavily gas, mud, and water cut oil, 332' heavily gas and slightly oil cut water cushion, 1700' heavily gas and mud cut water cushion
IFP 770# FFP 1010# SIP 4680#.

DST #12 12,000-12,050. 3 hr. and 10 min test - 30 min SIP. Run 2000' W.C. Recovered 2000' water cushion and 644' salt water. IFP 950# FFP 1190# SIP 4660#.

DST #13 13,350-13,493. 3 hr. test - closed 30 min. Test not completed - tools left in hole.

Casing Record:

Set 629 feet of 13 3/8" OD 48# H-40 surface casing. Amount and type of cement not given. Not recovered.

Set 10,058' of 7" intermediate casing (23, 26, 29# J-55 and N-80?). Further information as to cementation or type of casing actually used was not given. The 7" casing was shot off at 5247' and casing left in hole from 5247-10,058'.

Plugging Record:

Depth Plugs set	Sacks Cement	
13,825-13,545	50	
12,695-19 12,415	50	
10,898-10,718	50	
10,058-9808	50	(Bottom of 7" casing)
5,060' - Set bridge and dumped	5	sacks cement on top of bridge.
629-590	30	(bottom of 13 3/8" casing)
Top and marker	10	

Formation tops were determined from samples, electric logs, and radioactivity logs. Doubtful or obscure formation tops were not picked. Color names and identifying numbers are taken from the 1948 Rock-Color Chart which is distributed by the National Research Council, Washington, D.C.

FORMATION TOPS

Cretaceous System	
Pierre formation	2053
Judith River (?) sandstone	3222
Niobrara formation	4370
Greenhorn formation	4770
Dakota group sandstones	
"Muddy"	5276
Basal sandstones	5580
Jurassic System	5828 (?)
Rierdon formation	6542
Piper limestone	6870
Triassic System (?)	
"Spearfish formation"	6995
salt "A"	7033
salt "B"	7328
Permian System	
Minnekata formation	7514
Opeche formation	7545
Pennsylvanian System	
Minnelusa formation	7606
Amsden	7800
Mississippian System	
Big Snowy group	7990
Heath	
Otter	
Kibby	8411
Madison group	
Charles formation	8708
Mission Canyon formation	9673
Lodgepole formation	10,220
Bakken formation	10,928
Devonian system	
Lyleton formation (?)	11,010
Nisku formation	11,201
Duperow	11,306
Souris River	11,762
Dawson Bay	11,991

Prairie Evaporite	12,108
Winnepegosis	12,393
Ashern	12,578
Silurian system	
Interlake group	12,678
Ordovician system	
Stony Mountain	
Upper	13,658
Lower	13,801
Red River formation	13,858

0-20	Sandstone, light olive gray, fine to medium grained, calcareous, micaceous, 80%. Loose, coarse grained, rounded, quartz, 10%. Fragments of calcareous, claystone, concretions, 5%. Remaining percentages are fragments of lignite, and light yellow gray clay.
20-100	Lignite, 85%. Sandstone, as above 10%, remaining percentage is chiefly clay as above.
100-280	Sandstone, as above. Chiefly quartz - 90%. Lignite 5%. Rest, traces of clay and traces of pyrite.
280-440	Clay, light gray, massive, compact 90%. Lignite, 5%. Sandstone, as above, 5%.
440-520	Silt, light gray, with loose, fine grained quartz. Traces of lignite.
520-640	Samples missing.
640-700	Lignite, 85%. White chert fragments, 5%. Silt, light gray and light grayish red.
700-820	Lignite.
820-940	Lignite, 95%. Chert and silt, as above.
940-1080	Lignite, 60%. Silt, light gray 30%. Loose, fine grained quartz.
1080-1100	Samples missing.
1100-1400	Sandstone, light gray, calcareous, silty, very friable, fine-grained, angular and loose grains of quartz, fine grained (and some medium grained) angular. 70% of sample. Clay, very light gray, soft, 20% of sample. Traces of lignite. Traces of iron carbonate “pellets”
1400-1520	Sandstone, light gray, fine to medium grained, calcareous, well to loosely cemented mainly angular quartz. 80%, of sample. Clay, light gray, massive.
1520-1620	Sandstone, as above, 50% of sample. Clay, light gray, 40%. Lignite remainder.
1620-1720	Sandstone as above, 20%. Clay, as above, 30%. Silt, light gray 30%. Lignite 20%.
1720-1880	Sandstone, very-to-fine-grained, quartzose, light gray, calcareous and much silt. About 20% light gray, silty clay
1880-2160	Lignite, clay, sandstone, as above. Traces of very-fine-grained, calcareous light gray sandstone.
2160-2200	Silt, light gray, with traces fine grained quartzose sandstone. About 60% lignite.
2260-2300	Shale, medium gray, lumpy, spongy, silty. About 70% cavings.
2300-3240	Shale, medium gray, lumpy, compact to spongy, micro-micaceous. Traces of pyrite.
3240-3420	Shales, as above. Samples consist of 5% or less fine grained, loose to calcareous cemented light gray sandstone.

3420-3520	Shale, as above.
3520-3780	Shale, medium gray, calcareous, massive. Traces of light gray limestone, pyrite.
3780-4300	Shale, medium gray, lumpy, spongy, silty, micro-micaceous. Traces of calcite prisms.
4300-4400	Shale, as above, and traces of light gray bentonite.
4400-4500	Shale medium gray to medium dark gray, massive, compact, calcareous, and "white specks". Traces of calcite prisms.
4500-4700	Shale, medium dark gray, massive to platy, calcareous. Traces of calcite prisms.
4700-4840	Shale, as above, poor samples.
4840-5000	Shale, dark gray, calcareous, massive. Traces of loose calcite prisms and prisms cemented to form a gray limestone. Traces of "white specks" and pyrite.
5000-5480	Shale, medium dark gray, platy, compact. The electric and radio-activity logs show a "kick" at 5278 that has the same stratigraphic position as the "Muddy" sandstone. At 5360-5400 a few fragments of silty, very fine grained sandstone were found.
5480-5680	Shale, medium dark gray, laminated to massive. Samples contain a few fragments of light gray siltstone and very fine grained quartzose sandstone. Traces of pyrite.
5680-5740	Sandstone, light gray, fine to medium grained, angular to rounded, quartzose, with shale, medium dark gray, flaky.
5740-5840	Shale, as above, with about 10% sandstone, as above and traces of loose, coarse grained angular, clear and white quartz.
5840-5860	Samples missing.
5860-5900	Shale, as above, samples contain 10% sandstone as above. Traces of loose, coarse, grained quartz siderite "pellets" and light olive gray massive, waxy, shale.
5900-6080	Shale, as above. The samples contain 15% very light gray, fine grained quartzose sandstone, calcareous cement.
6080-6300	Shale, as above. Samples contain 25% greenish gray (5GY6/1), very fine grained to silty calcareous sandstone that contains a green mineral. Traces of greenish gray, massive, waxy shale. At 6160-6180 a sandstone fragment that contains glauconite was found.
6300-6360	Shale, greenish gray (5GY4/1), platy and splintery, micro-micaceous, waxy. Traces of sandstone, as above. About 20% gray shale.
6360-6450	Shale, as above. The samples also contain about 5% fine grained, light gray, calcareous, quartzose sandstone.
6450-6770	Shale, as above. Traces of vuggy, coarse crystalline, light gray limestone at 6720-6730.
6770-6830	Shale, as above. The samples contain about 10% brownish gray, sublithographic limestone (coarse crystalline, brown inclusions), and shale, reddish brown, calcareous.
6830-6870	Shale, as above. The samples contain about 40% medium gray shale, calcareous splintery, compact. Furthermore, about 15% of the sample is shale, reddish brown, calcareous, massive, compact, waxy.
6870-6910	Shales, as above. Traces of limestone, light gray to medium light gray, dense, sublithographic.
6910-7040	Limestone, light gray to pinkish gray, fine crystalline to sub-lithographic, dense, about 30% of sample. Trace of white, primary chert. Shales as above.

7040-7100	Limestone and shale as above. Traces of white gypsum and anhydrite.
7100-7250	Sample as above. About 3% of sample is reddish brown. Shale, silt, and fine-grained quartzose sandstone.
7250-7330	Silt, reddish brown; shale, dark reddish brown; and sandstone, pale reddish brown, quartzose. Traces of well rounded, frosted, loose quartz grains.
7330-7530	Samples as above and appear to be cavings. Traces of anhydrite.
7530-7540	Salt, about 50% of sample. Silt, shale, sandstone and loose quartz grains as above.
7540-7590	Poor samples, lithology as above.
7590-7600	Samples missing.
7600-7860	Silt, pale reddish brown, anhydrite filling, about 30% of sample. Traces of anhydrite. About 60% of sample is gray shale. Traces of light brownish gray, very fine grained limestone. Reddish brown shale, about 2% of sample.
7860-7900	Dolomite, grayish pink, very fine grained to sublithographic, cherty, about 30% of sample. Sandstone, anhydritic and calcareous, grayish pink, very fine grained, about 5% of sample. About 5% of sample greenish gray massive shale. Rest of sample is mainly gray shale and silt as above.
7900-8020	Dolomite, grayish pink, very fine grained crystalline, dense, cherty. Traces of sandy dolomite, anhydritic. Traces of vugular porosity in the dolomite. Traces of white and grayish pink chert.
8020-8100	Shale, moderate red, waxy, platy. Dolomite, as above. About 5% gray shale.
8100-8150	Shale, grayish red, waxy, platy. Shale as above. Traces of light brown shales. Sample contains 5% gray shale.
8150-8250	Shale, black or very dark gray, massive to platy, slightly calcareous. Red and brown shales as above.
8250-8300	Shale, gray, splintery and greenish gray, splintery shale. Red shale, as above, with gray limestone, fine crystalline.
8300-8400	Limestone, gray, generally fine grained, crystalline. Shales as above, the limestone from 8350-8400 contains traces of fine to medium grained fragmental limestone, from 8370-8400 gray shale makes up about 85% of the sample.
8400-8470	Poor samples, cavings.
8470-8600	Sandstone, pale red to white, fine to medium grained, calcareous in part, about 10% of samples. Shales as above. Traces of coarse grained, loose, iron stained and frosted quartz. Pale red silt, about 5% of sample, at 8580-8600.
8600-8642	Shales, as above.
8642-	Circulation, 2 hours. Shale, as above with about 10% of sample consisting of white and clear anhydrite.
8650-8740	Shales as above.
8740-8820	Shales, as above. By stratigraphic position this should be, during drilling the first Mississippian salt. The samples consist of about 60% gray shale; 15% pale red shale; 5% moderate red shale; 5% greenish gray shale; and the remainder consists of white to clear anhydrite, reddish brown sandstone, grayish orange pink limestone, and traces of pyrite.
8820-8920	Salt, about 10% of samples, and shales as above.
8920-8940	Shales, as above. Traces of dense, white anhydrite.
8940-8970	Salt, about 30% of samples. Shales as above.

8970-9000 Shales, as above. 10% of samples is anhydrite, dense, white.
9000-9030 Salt, shales as above.
9030-9080 Shale, gray with fine grained fragmental, light gray to brownish gray, shaly limestone. Salt in samples. About 15% of samples are anhydrite. At 9060-9080 the shaly limestone is about 80% of the samples.
9080-9130 Salt, shales, limestone and anhydrite, as above.
9130-9170 Limestone, brownish gray, very fine grained, crystalline. Limestone, shale, and anhydrite, as above.
9170-9360 Limestone, brownish gray to light gray, fine to medium grained fragmental and fine grained, crystalline. Shales as above, by stratigraphic position from "kicks" on the laterolog this section should consist chiefly of salt. There are traces of salt in the samples, much white to light gray anhydrite.
9360-9390 Salt, cavings as above.
9390-9400 Sample missing.
9400-9450 Limestone, fine grained, crystalline and fragmental, brownish gray to gray, about 30% of sample. Shale, light gray, calcareous, anhydritic about 30% of sample. Anhydrite, white to light gray, about 30% of sample.
9450-9496 Anhydrite and anhydritic limestone, very fine grained crystalline. Limestone and shales as above.
9496- Circulation, 3 hours. Samples as above.

Core #1
Core Chip Description (recovered 58 feet)
9496-9505 Anhydrite, white to gray, dense.
9505-9510 Limestone, brownish gray, very fine grained, crystalline, anhydritic.
9510-9515 Limestone, as above, with brown crystals of anhydrite, traces of oil.
9515-9525 Dolomite, brownish gray, very fine grained crystalline to sub-lithographic, anhydritic.
9525-9530 Limestone, brownish gray, coarse crystalline, with dark gray chert.
9530-9535 Limestone, brownish gray, fragmental, medium grained, with bands of gray anhydrite and brownish gray dolomite.
9535-9540 Limestone, brownish gray to medium gray, very fine crystalline, dense.
9540-9545 Limestone, medium light gray, fine grained, fragmental.
9545-9550 Limestone, brownish gray, fine to coarse grained, crystalline.
9550-9554 Limestone, light gray, fine grained, fragmental.

Core #2 (recovered 59 feet)
9557-9560 Limestone, medium light gray, fragmental, fine to coarse grained, oolitic.
9560-9565 Limestone, medium dark gray, shaly, fragmental, fine to coarse grained, to crystalline, very fine to coarse crystals.
9565-9575 Limestone, medium gray, fragmental, fine to coarse grained. Somewhat recrystallized.
9575-9585 Shale, dark gray, very calcareous and grades into limestone, slightly pyritic.
9585-9590 Limestone, brownish gray, fragmental, coarse grained, re-crystallized.

9590-9595 Limestone, medium gray, fragmental to crystalline, thin bands of dark gray shale.
9595-9616 Limestone, medium dark gray, subcrystalline, dense. The limestone shows fragmental origin by recrystallized shell fragments (coarse grained), and a fine grained shaly matrix. The chips show very thin bands of black shale.

Core #3 (recovered 58 feet)
9616-9625 Limestone, as above.
9625-9630 Shale, dark gray, calcareous.
9630-9645 Limestone, medium dark gray, subcrystalline, dense, the limestone is chiefly recrystallized fragmental and size ranges from fine to very coarse grained, shaly. Shell and crinoidal fragments.
9645-9650 Limestone, medium light gray, fragmental oolitic, fine to medium grained, porous, pinpoint porosity.
9650-9655 Limestone, light brownish gray, subcrystalline, fine to coarse grained. Apparently once fragmental and oolitic, but re-crystallized. Very porous.
9655-9665 Limestone, light gray, fragmental, shell and pseudo-oolitic, fine to medium grained. Fair pinpoint porosity. Much recrystailization.
9665-9670 Limestone, medium dark gray, fine grained subcrystalline, dense, shaly with scattered recrystallized shell fragmentals.
9670-9674 Limestone, medium gray, subcrystalline fine to medium grained, chiefly recrystallized fragmental.

Core #4 (recovered 58 feet)
9677-9680 Limestone, medium gray, subcrystalline, fine-medium grained, dense, shaly with scattered coarse grained, fossil fragments, recrystallized.
9680-9685 Limestone, medium dark gray, crystalline to fragmental, fine coarse grained.
9685-9690 Limestone, medium dark gray, fine grained crystalline, banded, shaly, with some coarse grained fragmental.
9690-9735 Limestone, medium dark gray, dense, fine to very coarse grained, subcrystalline and coarse grained, fragmental, recrystallized.

Core #5 (recovered 58 feet)
9735-9760 Limestone, as above.
9760-9765 Limestone, medium light gray, fragmental, fine to very coarse grained, much recrystailization.
9765-9793 Limestone, medium gray to medium dark gray, crystalline, dense, fine to very coarse grained, apparently the limestone was originally fragmental. Thin bands of dark gray shale.

Core #6 (recovered 58 feet)
9793-9800 Limestone, as above.
9800-9810 Limestone, as above but becoming very coarse grained and more porous.
9810-9820 Limestone, medium light gray, fragmental, fine to coarse grained much recrystallization, subcrystalline.
9820-9830 Limestone, brownish gray, fragmental, subcrystalline, fine-coarse-grained.
9830-9835 Limestone, medium light gray, fragmental, fine-coarse-grained, angular to rounded, subcrystalline to grainy.

9835-9851 Limestone, medium gray, fragmental, fine-coarse-grained, sub-crystalline, angular to rounded.

Core #7 (recovered 58 feet)
9851-9855 Limestone, as above.
9855-9860 Limestone, medium light gray, fragmental, fine-coarse-grained, grainy, psuedo-oolitic to subcrystalline.
9860-9870 Limestone, medium gray to brownish gray, fragmental, fine-coarse-grained, subcrystalline, angular to rounded.
9870-9875 Limestone, medium light gray, fragmental, subcrystalline to psuedo-oolitic, medium grained, rounded.
9875-9895 Limestone, medium dark gray, fragmental, fine-coarse-grained, angular to rounded, subcrystalline.
9895-9909 Limestone, medium gray, fragmental, fine-medium-coarse-grained, subcrystalline, angular to rounded.

Core #8 (recovered 58 feet)
9909-9920 Limestone, as above.
9920-9930 Limestone, medium dark gray, fine-coarse-grained, fragmental, dense, subcrystalline, thinly banded with dark gray shale.
9930-9955 Limestone, medium gray to brownish gray, fragmental, dense, fine-coarse-grained, subcrystalline, angular.
9955-9960 Limestone, medium gray, fragmental, dense, fine-medium-grained, somewhat siliceous, angular to rounded.
9960-9965 Limestone, medium dark gray, fragmental, fine-coarse-grained, subcrystalline, with dark gray dense shale bands.
9965-9967 Limestone, light gray, fragmental, fine-coarse-grained, sub-crystalline.

Sample Description.
9965-9980 Limestone, light gray, and brownish gray, fragmental, fine to coarse grained, subcrystalline, about 10% of the sample. Remainder chiefly gray shale.
9980-10,000 Limestone, as above except light gray limestone about 70% of the sample.

Core Chip Description
Core #9
10,002-10,010 Limestone, medium dark gray, fine crystalline, with shale inclusions and chert inclusion from 10,005-10,010.
10,010-10,015 Limestone, medium dark gray, fragmental, fine-coarse-grained, subcrystalline.
10,015-10,020 Limestone, light gray, fragmental, dense, fine-coarse-grained, subcrystslline.
10,020-10,025 Limestone, medium dark gray, fine crystalline.
10,025-10,030 Limestone, light olive gray, fragmental, coarse-grained, rounded, psuedo-pisolitic and subcrystalline.
10,030-10,035 Limestone, light olive gray, fragmental, medium-grained, rounded and angular subcrystalline.
10,035-10,040 Limestone, medium dark gray, fragmental, coarse-grained, sub-crystalline, and fine crystalline. Thin dark gray shale bands.
10,040-10,045 Limestone, brownish gray, fragmental, fine-coarse-grained, subcrystalline.

10,045-10,050 Limestone, medium dark gray, fragmental, subcrystalline, and dark gray, thin shale bands.
10,050-10,055 Limestone, brownish gray, fine-medium-grained, crystalline, dense.
10,055-10,060 Limestone, medium dark gray, crystalline, dense, dolomitic and cherty.

Core #10 (recovered 25 feet)
10,060-10,085 Limestone, medium dark gray, crystalline, fine-medium-grained, dense, thin shale bands.

Sample Description
10,085-10,102 Limestone, medium gray, fragmental, dense, fine grained, grainy to subcrystalline, traces of pyrite.
10,102-10,105 Limestone, as above.
10,105-10,115 Casing cement.
10,115- Circulation, 2 1/2 hours, casing, cement.
10,115-10,120 Casing cement.
10,120-10,160 Limestone, medium dark gray to brownish gray, fragmental, fine-coarse-grained, subcrystalline. About 80% of the sample is casing cement.
10,160-10,230 Limestone, medium gray to brownish gray, fragmental, sub-crystalline to crystalline, fine to coarse grained. Generally the samples consist of about 60% of brownish gray fine crystalline dense limestone. Traces of pyrite.
10,230-10,450 Limestone, light gray to medium gray, fine-grained, crystalline, shaly to fragmental, subcrystalline, shell fragments.
10,450-10,490 Limestone, brownish gray, dense, fine-grained, crystalline, about 40% of samples. Limestone, as above.
10,490-10,750 Limestone, light gray to medium gray, shaly fine grained, crystalline to coarse fragmental, subcrystalline. Shell fragments. Traces of dark gray limey shale chips. About 60% of the sample is light gray limestone.
10,750-10,850 Limestone, medium dark gray to brownish gray, dense, fine grained crystalline, about 60% of sample. Limestone as above.
10,850-10,930 Limestone, light gray, as above. The dark gray shale content increases from traces to about 5% of the samples.
10,936- Circulation, 2 1/2 hours. Limestones as above. About 5% of the sample is black, flaky; velvety shale.
10,936-10,940 Limestone and shale, as above.
10,945- Circulation, 1 1/2 hours. Shale, dark gray to black flaky, velvety to sooty.
10,945-10,960 Shale, as above.
10,960-10,980 Shale, as above. Siltstone and very fine grained sandstone, light gray, dense, calcareous, about 15% of samples.

Core Chip Description
Core #11 (recovered 58 feet)
10,984-10,990 Siltstone, medium gray, calcareous, becoming shaly toward base.
10,990-11,002 Missing.
11,002-11,020 Shale, black, dense, flaky, velvety.
11,020-11,030 Silt and very fine grained sandstone, brownish gray, dolomitic.

11,030-11,035 Shale, greenish gray (5GY6/1), dense, pyritic, dolomitic, interbedded with dense, brownish gray fine crystalline dolomite.
11,035-11,042 Dolomite, brownish gray, dense, fine crystalline.

Sample Description
11,040-11,050 Shale, greenish gray (5GY6/1), dense, pyritic, with black shale and dolomite as above.
11,050-11,060 Dolomite, light brownish gray, microgranular and silty to fine-grained dolomitic sandstone. Greenish gray shale as above.
11,060-11,100 Dolomite, light brownish gray, microgranular, and sandy (very fine grained) in part. Greenish gray shale as above.
11,100-11,130 Dolomite, as above. Greenish gray shale as above. Pale red (5R6/2) calcareous shale, about 60% of the samples.
11,130-11,150 Dolomite, light brownish gray to pale red (10R6/2), micro-granular. Red shales make up about 50% of the samples. Greenish gray shales, as above, in small amount. Traces of anhydrite.
11,150-11,180 Shale, pale red (5R6/2), dolomitic, and small amounts of anhydrite.
11,180-11,200 Shale, greenish gray, dolomitic. Rest of samples as above.
11,200-11,215 Dolomite, pale red (10R6/2) microgranular and dense anhydrite, shales as above.
11,215- Circulation 1 1/2 hour. Limestone, brownish gray, dense, crystalline. A few fragments of anhydrite.
11,215-11,230 Limestone, as above, and fragments of anhydrite.
11,230-11,245 Circulation 1 1/2 hour. Limestone, as above. About 10% of the sample is light brownish gray, granular, anhydrite filled dolomite and chips of anhydrite. Some of the dolomite chips are friable and very porous.
11,245- Circulation, 4 hours. Samples as above.

Core Chip Description
Core #12 (recovered 58 feet)
11,245-11,247½ Dolomite, limey medium dark gray, dense, crystalline.
11,247½-11,251 Anhydrite, dense, crystalline.
11,251-11,260 Limestone, dolomitic light brownish gray, granular, anhydrite inclusions. Dead oil stain.
11,260-11,301 Limestone, light brownish gray, microgranular, slightly fossiliferous, dense, with some fine grained crystalline.
11,301-11,303 Dolomite, light gray, shaly, microsucrosic, styolitic.

Sample Description
11,300-11,320 Limestone, light brownish gray, microgranular to dense crystalline, about 60% of the samples. Limestone, brownish gray, fragmental to dense, fine crystalline, about 30% of samples. Shale, dark gray, light gray shaly dolomite, make up rest of samples.
11,320-11,350 Limestone, pale yellowish brown, fragmental, recrystallized with gray, dense, anhydrite.
11,350-11,460 Limestone, dolomitic and anhydritic, dense, fragmental to crystalline, medium gray. Anhydrite, light gray dense, fine crystalline. Shale, medium gray.
11,463- Circulation 1 1/2 hours. Limestone, yellowish gray, dolomitic, anhydrite inclusions, microgranular. Limestone as above.

11,463-11,510 Limestone, brownish gray to medium dark gray, fragmental, anhydritic microgranular, and dense, crystalline. Limestone, yellowish gray, as above.
11,511- Circulation, 1 1/2 hours. Limestone, as above.

Core Chip Description
Core #13 (recovered 33 feet)
11,511-11,515 Anhydrite and gray shale.
11,515-11,522 Anhydrite, dense.
11,522-11,544 Limestone, medium dark gray to brownish gray, dense, brittle, fine crystalline. Dead oil stain?

Sample Description
11,540-11,550 Limestone, medium dark gray to brownish gray, dense, fine crystalline.
11,550-11,680 Limestone, dolomitic and anhydritic, medium dark gray to brownish gray, dense, fine crystalline. Chips of dense gray anhydrite and gray shale.

Core Chip Description
Core #14 (recovered 58 feet)
11,682-11,686 Limestone, brownish gray to medium dark gray dense, fine-grained, crystalline.
11,686-11,692 Dolomite, light brownish gray, dense, microgranular.
11,692-11,703 Limestone, dolomitic, medium dark gray, dense, very fine crystalline to sublithographic.
11,703-11,707 Limestone, dolomitic, brownish gray, dense, fragmental, sub-crystalline to fine crystalline and sublithographic.
11,707-11,710 Limestone, dolomitic, light brownish gray, fine-coarse-grained subscrystalline fragmental to crystalline.
11,710-11,714 Limestone, dolomitic, light brownish gray, microgranular, shale streaks.
11,714-11,720 Dolomite, limey, brownish gray, microgranular to crystalline.
11,720-11,725 Limestone, shaly, light gray, styolite development.
11,725-11,730 Limestone, brownish gray, dense, fine crystalline, shaly.
11,730-11,740 Limestone, medium dark gray to brownish gray, dense, very fine grained microgranular to crystalline. Shale streaks and inclusions.
11,740-11,744 Chips missing.

Sample Description
11,740-11,770 Limestone, brownish gray to medium dark gray, very fine grained fragmental, subcrystalline and dense crystalline with dark gray shale.
11,770-11,780 Shale, light gray, very calcareous.
11,780-11,800 Limestone, as above.
11,800-11,820 Shale, light gray, very calcareous. Limestone as above.
11,820-11,970 Limestone, dolomitic, medium dark gray to brownish gray, dense, very fine grained, crystalline. Dark gray shale, brittle, calcareous. Traces of anhydrite at 11,960-11,970.
11,978- Circulation 1 1/2 hours. Dolomite, limey, yellowish to light gray, dense, microgranular, traces of vugs.
11,970-11,990 Dolomite, as above.
11,990- Circulation 1 1/2 hours. Dolomite and limestone, as above.

11,990-12,010 Limestone and dolomite, as above.
12,010-12,020 Dolomite, brownish gray, anhydritic, granular, vuggy and intergranular porosity.
12,022- Circulation 1 1/2 hours. Dolomite as above.

Core Chip Description
Core #15 (recovered 22 feet)
12,026-12,040 Dolomite, medium dark gray to brownish gray, vugular, fine to coarse crystalline. Salt inclusions.
12,040-12,048 Dolomite, brownish gray, dense, fine-medium crystalline. Salt inclusions.

Sample Descriptions
12,050-12,090 Dolomite, brownish gray, granular to rhombic, good intergranular and vuggy porosity.
12,090-12,120 Dolomite, as above, and dense, brownish gray, limey dolomite, fine crystalline to sublithographic.
12,120-12,150 Dolomite, as above and light gray, microgranular limestone, the prairie evaporites began at 12,120 according to the "R" log.
12,150-12,350 Shale, light brown. The shales that are interbedded with the salts. Traces of salt crystals. From 12,310-12,350 are found many crystals of apatite.
12,350-12,720 Shale, as above, also small amounts of medium dark gray dense crystalline limestone, light gray fine granular limestone, and dark gray shale. From 12,650-12,720 there are traces of pale red shale and pale red dolomite.
12,720-12,730 Dolomite, grayish pink, dense, very fine grained to sublithographic. Remainder of sample as above.
12,730- Circulation, dolomite as above.

Core Chip Description
Core #16 (recovered 58 feet)
12,730-12,735 Dolomite, limey, light brownish gray, fragmental, fine-medium-grained rounded.
12,735-12,740 Dolomite, limey, light gray, fine-grained, granular.
12,740-12,745 Dolomite, limey, white to pinkish gray, fragmental, vugs (filled with calcite), inclusions of anhydrite.
12,745-12,750 Dolomite, limey, very light gray, fragmental, fine to very coarse grained, angular to rounded.
12,750-12,755 Dolomite, limey, medium gray to brownish gray, dense, fine crystalline, vuggy porosity.
12,755-12,760 Dolomite, limey, medium light gray, fragmental, fine to coarse-grained, angular to rounded, vuggy porosity, shows the recrystallization very well.
12,760-12,765 Dolomite, limey, white to pinkish gray, dense very fine grained, microgranular to sublithographic.
12,765-12,770 Dolomite, limey, white to very light gray, fragmental, fine-coarse-grained, angular to rounded, vugular porosity.
12,770-12,788 Dolomite, limey, white to light gray, dense, fine-grained, microsucrosic to crystalline to sublithographic.

Core #17 (recovered 58 feet)
12,788-12,789 Dolomite, limey, pinkish gray, fine-grained, microgranular.
12,789-12,793 Shale, dolomitic, pale red (10R6/2), dense.

12,793-12,798 Dolomite, limey, white, microgranular.
12,798-12,815 Dolomite, limey, white to light gray, microgranular with recrystallized, coarse fragments.
12,815-12,830 Dolomite, limey, pinkish gray to light gray, fine grained, microgranular to crystalline.
12,830-12,846 Dolomite, white to light gray, dense, fine grained microgranular, with inclusions of coarse grained, fragmental (recrystallized) limey dolomite.

Sample Description
12,840-12,980 Dolomite, white to very light gray and pinkish gray, very fine grained, microgranular to dense fine crystalline and sublithographic.
12,980-13,210 Dolomite, light brownish gray to light gray, dense, fine-grained, crystalline.
13,210-13,350 Dolomite, light brownish gray to light gray, crystalline, fine to coarse crystal size, rhombic and anhedral crystals. Traces of vugular porosity.
13,350-13,400 Dolomite, light brownish gray, dense, fine-grained, crystalline.
13,400-13,430 Dolomite, brownish gray, dense, very fine crystalline to sublithographic.

Core Chip Description
Core #18 (recovered 58 feet)
13,435-13,445 Anhydrite, dense, inclusions of dark gray shale.
13,445-13,450 Dolomite, medium dark gray to brownish gray, dense, sublithographic, shaly.
13,450-13,455 Dolomite, brownish gray, dense, very fine grained crystalline to sublithographic.
13,455-13,460 Shale, dark gray dolomitic, interbedded with thin anhydrite stringers.
13,460-13,465 Dolomite, medium dark gray to brownish gray, dense, sublithographic, with anhydrite inclusions.
13,465-13,470 Dolomite, light brownish gray, fine-grained, microgranular, traces pinpoint porosity.
13,470-13,485 Dolomite, brownish gray, fine crystalline, with scattered anhydrite inclusions. Thin dark gray shale streaks.
13,485-13,493 Dolomite, brownish gray, fine-grained, microgranular.

Sample Description
13,500-13,625 Dolomite, brownish gray, fine-grained, microgranular to crystalline, dense. Traces of anhydrite. Anhydrite increases at 13,600-13,630.
13,625- Circulation, 3 hours. Dolomite, as above.

Core Chip Description
Core #19 (recovered 4 feet)
13,625-13,638 Dolomite, brownish gray, dense, fine grained crystalline to sublithographic.

Core #20 (recovered 55 feet)
13,638-13,651 Dolomite, as above.
13,651-13,653 Shale and dolomite interbedded, dark gray.

13,653-13,675 Dolomite, medium gray, dense, fine-grained, crystalline, shaly and shale interbeds.
13,675-13,680 Limestone, dolomitic, medium dark gray, very fine grained to sublithographic.
13,680-13,690 Limestone, medium dark gray to brownish gray, fragmental, fine-coarse-grained, much recrystallized.
13,690-13,693 Limestone, medium light gray, very shaly, with dark gray shale inclusions.

Core #21 (recovered 58 feet)
13,693-13,696 Limestone, medium gray, shaly, dense, with medium dark gray shale inclusions.
13,696-13,698 Anhydrite, gray, dense, crystalline.
13,698-13,702 Shale, dark gray, very compact, limey.
13,702-13,710 Limestone, medium dark gray, shaly, dense, grading upward into dark gray shale.
13,710-13,725 Limestone, medium dark gray, dense, shaly, very fine grained, crystalline.
13,725-13,729 Limestone, medium gray, dense, fine grained crystalline, siliceous. Traces of well rounded quartz grain.
13,729-13,736 Dolomite, medium dark gray to brownish gray, fine grained, crystalline, very dense.
13,736-13,739 Dolomite, brownish gray, very fine grained crystalline to sub-lithographic.
13,739-13,746 Dolomite, light brownish gray, very fine grained, crystalline interbedded with gray shale, shaly and silty.
13,746-13,751 Dolomite, light brownish gray, fine grained, microgranular and crystalline, dense, shaly and silty.

Core #22 (recovered 58 feet)
13,751-13,765 Dolomite, light brownish gray, fine grained, crystalline, shaly, inclusions of gray shale.
13,765-13,770 Dolomite, brownish gray, dense, very fine grained, crystalline.
13,770-13,775 Dolomite, light brownish gray, fine grained, crystalline, shaly, with gray shale inclusions.
13,775-13,790 Limestone, dolomitic, light brownish gray, fine to coarse grained crystalline, shaly and gray shale inclusions.
13,790-13,795 Limestone, medium dark gray, very dense, very fine grained, crystalline to sublithographic.
13,795-13,806 Limestone, medium dark gray, fine-coarse-grained, crystalline, thin shale interbeds.
13,806-13,809 Limestone, medium gray, fine-grained, crystalline, dense, very shaly.

Core #23 (recovered 58 feet)
13,809-13,860 Limestone, as above.
13,860-13,865 Limestone, medium gray, fragmental, very fossiliferous.
13,865-13,867 Limestone, dolomitic, medium dark gray, very fine grained, crystalline, thin dark gray shale interbedding.

Core #24 (recovered 58 feet)
13,867-13,870 Limestone, as above.
13,870-13,885 Limestone, medium dark gray, dense, fine grained, crystalline.

13,885-13,895 Limestone, brownish gray, dense, fine grained, crystalline with scattered coarse grained crystals.
13,895-13,898 Dolomite, medium gray, dense, fine grained, with gray shale streaks.
13,898-13,901 Anhydrite, dense, crystalline.
13,901-13,905 Dolomite, brownish gray, dense, very fine grained to sub-lithographic.
13,905-13,925 Limestone, medium dark gray, shaly, dense, very fine grained, crystalline. Actually grades from a brownish gray shaly dense limestone to a dark gray limey shale.

Core #25 (recovered 58 feet)
13,925-13,931 Anhydrite, dense, crystalline.
13,931-13,933 Dolomite, light brownish gray, dense, fine grained, crystalline. Many inclusions of anhydrite.
13,933-13,936 Dolomite, light brownish gray, dense, very fine grained to sublithographic.
13,936-13,938 Dolomite, brownish gray, dense, fine grained, crystalline.
13,938-13,942 Shale, dark gray and limestone, shaly dense, fine grained, crystalline.
13,942-13,947 Dolomite, light brownish gray, dense, very fine grained.
13,947-13,950 Limestone, medium dark gray, shaly, dense, very fine grained.
13,950-13,955 Limestone, medium gray, fragmental, fine-coarse-grained, recrystallized, shaly, and dark gray shale interbeds.
13,955-13,960 Limestone, dark gray, dense, very fine grained, crystalline.
13,960-13,965 Limestone, medium gray to brownish gray, dense, fine to coarse grained, fragmental, recrystallized.
13,965-13,970 Limestone, medium dark gray, dense, fine grained, crystalline, shaly.
13,970-13,977 Limestone, medium gray, fragmental, coarse grained. Thin shale interbedding.
13,977-13,983 Dolomite, medium gray, dense, shaly, very fine grained to sublithographic.

Core #26 (recovered 52 feet)
13,983-13,984 Dolomite, light brownish gray, dense, very fine grained, thinly banded.
13,984-13,988 Anhydrite, dense, crystalline and contains inclusions of dolomite.
13,988-13,995 Dolomite, medium dark gray, dense, sublithographic and dark gray shale, interbedded.
13,995-14,000 Dolomite, light brownish gray, dense, very fine grained, appears to have been fractured.
14,000-14,005 Dolomite, light brownish gray, dense, fine grained, crystalline.
14,005-14,014 Dolomite, light brownish gray to brownish gray, oolitic, fine to medium grained, dense.
14,014-14,020 Dolomite, brownish gray, dense, sublithographic, and thin gray shale interbeds.
14,020-14,030 Limestone, dolomitic, brownish gray, dense, fragmental, coarse-grained, recrystallized.
14,030-14,035 Limestone, light brownish gray, fragmental, fine medium grained, sharp to rounded fragments.
14,035 Total depth.