

NORTH DAKOTA GEOLOGICAL SURVEY CIRCULAR NO. 264

Summary of the Cardinal Drilling Company
N. A. Graves and Federal Land Bank #1
Foster County, North Dakota
Well No. 1112 - Permit No. 1124

By John P. Bluemle
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The Cardinal Drilling Company - N. A. Graves and Federal Land Bank #1, Foster County, North Dakota. Location: Center NE NE Section 23, T. 146N., R. 66W. Elevation: 1529 Ground, 1535 K.B., 1539 D.F., Total Depth: 3803.

The Cardinal Drilling Company - N. A. Graves and Federal Land Bank #1 was spudded April 11, 1956; drilled to a total depth of 3803 feet, found by and plugged April 27, 1956. No drill stem tests were taken and no cores were cut. Electric and microlaterolog were run by Schlumberger.

Logging Record:

Schlumberger electric log--Run one, 4/26/56, 205-3799
Schlumberger microlaterolog--Run one, 4/27/56, 1650-3795

Casing Record:

Set 8 5/8" surface casing at 199.28 feet with 125 sacks of cement.

Plugging Record:

<u>Plug Set</u>	<u>Sacks Cement</u>
2930 feet	15
2080 feet	15
1690 feet	15
Bottom Surface	10
Top Surface	5

Formation tops were determined from samples and electric logs. Doubtful or obscure formation tops were not picked. Color names are from the 1951 Rock Color Chart distributed by the Geological Society of America.

FORMATION TOPS

Cretaceous System

Niobrara Formation	672
Greenhorn Formation	1202
Belle Fourche Formation	1262
New Castle Formation	1548
Skull Creek Formation	1580
Fall River Formation	1688

Jurassic System

Undifferentiated	1888
Piper Formation	1951
Redbeds	2014

Mississippian System

Lodgepole Formation	2078
Basal Miss. Shale	2388

Devonian System	
Duperow Formation	2452
Souris River Formation	2601
Ordovician System	
Stonewall Formation	2674
Stony Mountain Formation	
Gunton Member	2788
Stoughton Member	2822
Red River Formation	2929
Winnipeg Formation	
Roughlock Member	3523
Icebox Member	3566
Black Island Member	3700
Cambrian System	
Deadwood Formation	3710
Pre Cambrian	3791
Total Depth	3803

200-220	Shale, medium light gray, slightly calcareous, massive, compact; sand, medium grained, angular to subangular.
220-260	Shale, medium gray, very slightly calcareous, resinous, massive, compact; a few pieces have pseudo-oolitic texture; becoming more resinous and less calcareous downward.
260-320	Shale, medium gray, resinous, micromicaceous, massive; a few fissile pieces.
320-360	Shale, medium dark gray, slightly calcareous, resinous, micromicaceous, massive, compact; black inclusions at 340.
360-400	Shale, as above, non-calcareous; becomes fissile at 380.
400-460	Shale, medium gray but with some grayish black chips; earthy, massive, brittle; black specks (biotite?) common, coal from 420-440.
460-480	Shale, as above, with rounded inclusions of limestone.
480-580	Shale, medium light gray, non-calcareous, resinous, massive, brittle, Inoceramus calcite prisms; becomes fissile at 500 feet; a few carbon streaks noted between 540-560.
580-600	Shale, light olive gray with tannish streaks, resinous, micromicaceous, massive, brittle; tends to be silty.
600-660	Shale, dark gray, earthy, foliated, soft; carbonaceous; micromicaceous; slightly more olive colored at 640.
660-680	Shale, dark gray; as above; bentonitic.
680-760	Shale, light brownish gray, highly calcareous, resinous, abundant white to tan calcareous specks, massive to fissile.
760-880	Shale, as above; white specks larger; limestone inclusions which tend to be pressed and flattened parallel to the bedding; biotite flakes at 800 feet. Some pyrite and quartz at 880.
880-1040	Shale, light olive gray, slightly calcareous; white specks.
1040-1080	Shale, light olive gray, slightly calcareous; surfaces coated with reddish brown silt and limonite stained.
1080-1180	Shale, olive gray, calcareous, resinous, disaggregated; silty at 1120.
1180-1200	Shale, olive gray, silty; highly calcareous; abundant shells (Inoceramus) and calcite prisms.

1200-1220 Shale, light olive gray, white specks; both limestone and calcite crystal inclusions in shale as well as free chips of calcite prisms which constitute about 40% of the sample; shale is compact and waxy.

1220-1280 Shale, brownish gray, as above but with less calcite and limestone; disaggregated, earthy.

1280-1340 Shale, dark gray, tiny white specks, calcareous, fissile, disaggregated and resinous.

1340-1420 Shale, medium dark gray. Slightly calcareous; fissile, disaggregated, earthy; becomes slightly bentonitic at 1360.

1420-1440 Shale, brownish gray, slightly calcareous; silty, fissile, disaggregated; bentonitic.

1440-1520 Shale, olive gray, non-calcareous; fissile, sooty lenses; bentonitic; brown surface stains; disaggregated.

1520-1600 Siltstone, medium light gray with an organic brownish caste; black inclusions of carbon; non-calcareous; disaggregated, some pyrite.

1600-1660 Shale, grayish black, very slightly calcareous, fissile; becomes moderately calcareous and medium gray at 1620.

1660-1680 Shale, as above; angular to subangular quartz sand grains, medium grained; pyrite grains.

1680-1700 Siltstone, yellowish gray, slightly calcareous with some chips of limestone of the same appearance; abundant quartz, as above and iron carbonate pellets.

1700-1720 Iron carbonate pellets; two predominating colors are a reddish hue and an orange hue; also shale and siltstone, as above.

1720-1740 Shale, grayish black, non-calcareous; fissile, resinous, slaty; micromicaceous; a few iron carbonate pellets.

1740-1780 Shale, olive gray, calcareous, black inclusions; massive, compact; abundant iron carbonate pellets.

1780-1820 Limestone, light olive gray, sucrosic; contains tiny iron carbonate pellets; dark brown inclusions and carbonaceous inclusions; bentonite chips.

1820-1860 Siltstone, dark yellowish brown, massive, slightly calcareous, compact; iron carbonate pellets.

1860-1900 Sand, medium grained, angular to rounded; mostly clear quartz, many pink and yellow grains.

1900-1960 Shale, medium gray to brownish gray; non-calcareous; silty; splintery to fissile, compact; also sand, as above; becoming bentonitic at 1920.

1960-2000 Shale, as above; limestone, light gray, sucrosic to oolitic; limestone is in rounded pebble forms as though transported in.

2000-2010 Siltstone, moderate reddish brown, slightly calcareous; sandy.

2010-2040 Shale, medium dark gray, light bluish gray bentonite; massive to fissile and brittle; siltstone, pale reddish brown, calcareous beginning at 2020.

2040-2060 Shale, medium gray, slightly calcareous; earthy, massive to fissile, brittle.

2060-2080 Limestone, dolomitic, very pale orange, microsucrosic, dense, non-porous.

2080-2090 Limestone, as above and sucrosic to slabby; some interstitial porosity but mostly dense.

2090-2110 Limestone; very pale orange to chalky, slabby to oolitic with interstitial porosity in the latter; also reddish brown calcareous siltstone and limestone, pale yellowish green, microsucrosic.

2110-2120 Limestone, pinkish gray, with dark reddish brown streaks and specks; chalky to slabby, fossiliferous.

2120-2130 Interval missing.

2130-2170 Limestone, pale red to pinkish gray, streaked and spotted; whorls and brecciations in red pieces; sucrosic and silty to slabby; negligible porosity; also large amounts of siltstone, light brownish gray, calcareous, porous. Color of limestone is extremely variable with shades of red predominating; fossiliferous at 2150.

2170-2220 Limestone, as above; pieces of greenish gray, bentonitic, calcareous, siltstone; fossiliferous; extremely vuggy and porous pinkish gray limestone at 2190.

2220-2230 Limestone, very pale orange, grainy to grainy with calcite inclusions; the latter is vuggy with intergranular and cavernous porosity.

2230-2250 Limestone, as above to light brownish gray, slabby, and dense; grayish red chips at 2240.

2250-2270 Limestone, very pale orange, irregularly oolitic; vuggy porosity, also silty and slabby chips.

2270-2350 Limestone, very pale orange, porous spherically oolitic-tiny oolites; also numerous dense chalky pieces; becomes very chalky at 2310-2320, a few chips of reddish brown siltstone throughout are probably cavings.

2350-2380 Limestone, very pale orange, slightly less porous; slabby to sucrosic with calcite inclusions; becomes more porous again at 2360; pinpoint to tubular porosity; becomes shaly at 2370.

2380-2400 Shale, color variable from all shades of gray to shades of green and brown; slightly calcareous to very calcareous; fissile to splintery; also limestone, as above; shale becomes predominantly reddish-brown at 2390.

2400-2440 Shale, light brown, highly calcareous, some anhydrite; silky, massive, compact; mixed with medium dark gray shale from 2410-2420.

2440-2450 Limestone, light brown, microsucrosic, pinpoint porosity; silty.

2450-2460 Limestone, pinkish gray, grainy to slabby, dense with some cavernous porosity; also light brown limestone as above.

2460-2500 Dolomite, calcic; grayish orange pink; sucrosic to subrhombic; excellent interstitial and drusy porosity; some light gray chert at 2480.

2500-2510 Limestone, dolomitic; pinkish gray with pale purple streaks; microsucrosic to grainy; essentially non-porous.

2510-2540 Dolomite, calcic; pale yellowish brown; rhombic to sucrosic; some porosity.

2540-2550 Limestone, very pale orange, slabby, dense.

2550-2560 Interval missing.

2560-2570 Limestone, very pale orange, microsucrosic; tubular and intergranular porosity.

2570-2600 Limestone, grayish orange pink; slabby to elliptically oolitic and containing whorls and brecciation; fractured; negligible porosity, fossiliferous; reddish brown speckling by silt at 2580.

2600-2660 Limestone, dolomitic; grayish orange pink but variable to pinker hues; microsucrosic, dense; becomes coarser with vuggy porosity at 2610; slightly darker at 2620 and becoming more porous with vugs and interstitial pores at 2630; some gypsum at 2630.

2660-2680 Limestone, dolomitic, grayish orange pink, as above but silty and with rounded inclusions of quartz.

2680-2690 Limestone, dolomitic, uniform light brown color; microsucrosic, non-porous, some light red chips.

2690-2700 Limestone, dolomitic; light red; microsucrosic, dense.

2700-2750 Dolomite, calcic; very pale orange, subcrystalline; ranges from very dense to vuggy porosity; fractured; color varies to pinker shades and light red at 2720, red silt included in the carbonate; becomes light again at 2740; fossiliferous.

2750-2790 Limestone, very pale orange, sucrosic to slabby; some pinpoint porosity; medium dark gray shale at 2760 and exceptionally well-rounded frosted quartz grains at 2780, many included in limestone as inclusions; high porosity.

2790-2830 Dolomite, calcic; very pale orange; subcrystallic to sucrosic; fractured; some pinpoint porosity, increasing downward.

2830-2860 Limestone, light brown, grainy, pinpoint porosity; medium gray shale at 2840; red siltstone at 2850.

2860-2890 Shale, grays and purples; calcareous; massive to splintery; chips of pale orange limestone.

2890-2930 Limestone, light brown, slabby, soft; shale, as above.

2930-2950 Limestone; very pale orange, slabby, dense, fractured; shale, as above, decreases downward.

2950-3010 Limestone, dolomitic; microsucrosic, grayish orange pink; has calcite inclusions at 2960 and is very pale orange.

3010-3030 Limestone, dolomitic; very pale orange, microsucrosic; some pinpoint porosity; slabby to oolitic at 3020-3030.

3030-3080 Dolomite, calcic; grayish orange pink; sucrosic; pinpoint porosity; intergranular porosity from 3050-3070.

3080-3100 Dolomite, as above; vuggy porosity; fossiliferous.

3100-3190 Dolomite, light brown, subcrystalline; dense; pinpoint porosity at 3140-3160; white chert from 3160-3190.

3190-3200 Interval missing.

3200-3220 Dolomite, as above; gray shale and siltstone, cherty.

3220-3250 Dolomite, chalky; dense; a few chips have a pinkish tinge; cherty; some oolitic chips have intergranular porosity.

3250-3290 Limestone, pinkish gray; sucrosic with angular calcite inclusions; gray and varicolored shales mixed in and predominating from 3270-3280.

3290-3350 Limestone, pinkish gray, cherty, slabby.

3350-3410 Limestone, pinkish to yellowish gray; microsucrosic to slabby; dense; becoming more slabby downward and fractured; fossiliferous at 3400-3410 (brachiopods).

3410-3440 Limestone, very pale orange, slabby.

3440-3450 Limestone, pinkish gray, slabby to sublithographic.

3450-3470 Limestone, pinkish gray, slabby; fossiliferous at 3460 (brachiopods); becoming slightly coarser downward; cherty.

3470-3510 Limestone, as above; shale, greenish gray (5GY6/1), splintery, highly calcareous; 3480-3510 are very poor samples.

3510-3550 Shale, greenish gray, slightly calcareous; fissile, brittle; becoming waxy at 3930; dissociates rapidly in acid or water.

3550-3560 Shale, greenish gray, fissile to splintery, calcareous; also shale, brownish gray, very slightly calcareous; slaty to splintery.

3560-3590 Shale, greenish gray, splintery, very slightly calcareous; waxy.

3590-3610 Shale, as above; with a tendency to a pinkish caste; very slightly calcareous.

3610-3630 Shale, greenish gray and grayish red purple (5RP4/2); splintery, brittle waxy, very slightly calcareous.

3630-3640 Shale, pale brown to dark yellowish brown (5YR5/2 to 10YR4/2) splintery, brittle, waxy, very slightly calcareous.

3640-3700 Shale, greenish gray and grayish red, splintery, brittle; red fraction increases downward. Interval 3650-3660 missing.

3700-3710 Sandstone, fine to medium grained, friable, much loose, medium to coarse, rounded quartz grains.

3710-3720 Dolomite, grayish red (5R4/2), sucrosic, glauconitic, silty.

3720-3740 Dolomite, grayish pink to grayish red, fine to medium crystalline, glauconitic, silty; interstitial porosity.

3740-3760 Dolomite, grayish red (10R4/2), rhombic to sucrosic and sandy, glauconitic; interstitial porosity.

3760-3770 Calcareinte, grayish red (10R4/2), cemented quartz grains; glauconitic.

3770-3800 Sandstone, medium to very coarse; rounded to subangular; loose quartz; calcareous cement; intergranular porosity.

3800-3802 Pink granite.

3803 Total depth.