

NORTH DAKOTA GEOLOGICAL SURVEY CIRCULAR NO. 167

Summary of the Cardinal Drilling Company - Arthur J. Gunning No. 1
Bottineu County, North Dakota
Well No. 949 - Permit No. 961

By James Peterson
March 1957

Cardinal Drilling Company - Arthur J. Gunning No. 1, Bottineau County, North Dakota. Location: NE/4 NE/4 Sec 15, T. 159N., R. 82W. Elevation: 1553 ground. 1563 K.B.

Cardinal Drilling Company - Arthur J. Gunning No. 1 was spudded August 15, 1955, drilled to a total depth of 5004 feet, found dry, and was plugged September 9, 1955.

Logging Record:

Electric, Gamma Ray-Neutron, Microlateral log, Laterolog by Schlumberger.

Coring Record:

4246 - 4275
4509 - 4516
4516 - 4529

Casing Record:

375' 8 5/8" Surface casing with 250 sacks cement.

Plugging Record:

15 sacks cement at 4630
15 sacks cement at 4025
15 sacks cement at 2640
15 sacks cement at 375
5 sacks top surface

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

FORMATION TOPS

Cretaceous System	
Pierre formation	810
Niobrara formation	1750
Greenhorn formation	2112
Dakota Sand	2640
Jurassic System	2996
Piper formation	3518
Triassic System	
Spearfish formation	3775
Mississippian System	
Charles formation	3997

Mission Canyon formation	4500
MC-2	4630
Lodgepole formation	4800

0-200	Sand, fair sorted, quartz, subround-round, medium grain size.
200-210	Gravel, poor sorting, subangular-rounded.
210-260	Shale, light gray, spongy, slightly calcareous, caving material.
260-350	Shale, medium light gray, spongy, slightly calcareous, cavings of gravel.
350-390	Shale, medium gray, spongy, lignitic material, lumpy.
390-410	Cement chips from casing.
410-420	Sample missing.
420-500	Shale, light gray, slightly calcareous, lumpy, spongy.
500-540	Shale, medium light gray, spongy-lumpy, silty, calcareous.
540-560	Shale, light gray, lumpy, slightly calcareous.
560-570	Shale, as above, shale, medium dark gray, lumpy.
570-600	Shale, very light gray, lumpy, calcareous.
600-630	Shale, medium dark gray, lumpy, some shale as above.
630-640	Shale, medium light gray, lumpy.
640-650	Shale, medium gray, lumpy.
650-690	Shale, medium light gray, lumpy, spongy, calcareous.
690-770	Shale, as above, compact.
770-840	Shale, light gray, medium light gray, compact.
840-870	Shale, as above, some medium light gray, spongy-lumpy, bentonite flakes.
870-950	Shale, as above, some medium gray, spongy-lumpy, bentonitic.
950-970	Shale, medium gray-medium light gray, compact-lumpy, inoceramus fragments, some spongy.
970-1000	Shale, as above, bentonite flakes.
1000-1060	Shale, medium gray-medium light gray, spongy, bentonite.
1060-1070	Sample missing.
1070-1120	Shale, medium gray, lumpy, bentonite flakes.
1120-1150	Shale as above, but not bentonitic, some medium light gray, spongy shale.
1150-1170	Shale, medium light gray, compact, soft, some lumpy-spongy shale as above.
1170-1180	Sample missing.
1180-1230	Shale as above.
1230-1300	Shale, light gray, compact, some contains very finely disseminated mica.
1300-1350	Shale, light gray, very light gray, compact, hard.
1350-1400	Shale, light gray, compact, massive.
1400-1420	Shale, medium dark gray, lumpy, slightly calcareous, some of the shale is spongy.
1420-1500	Shale, medium gray-medium light gray, lumpy, spongy, slightly calcareous a few bentonite flakes. Scattered inoceramus fragments and prisms.
1500-1550	Shale, medium gray, platy, some lumpy-spongy, bentonite flakes.
1550-1610	Shale, medium gray, spongy-lumpy, some contains small pieces of brownish siltstone, bentonite, siltstone content increases with depth.
1610-1690	Shale, medium light gray, lumpy-spongy, bentonitic, some siltstone as above.
1690-1700	Samples missing.

1700-1750 Shale, as above.

1650-1790 Shale, medium dark gray-medium light gray, spongy, lumpy, bentonite.

1790-1820 Shale, medium gray, platy, first "white specks". Shale cavings from above, inoceramus prisms.

1820-1830 Shale, medium dark gray, platy, shale cavings, inoceramus fragments.

1830-1850 Shale, medium light gray, compact, caving material.

1850-1870 Shale, medium gray-medium light gray, compact, lumpy, some spongy.

1870-1880 Shale, medium dark gray, platy, white specks.

1880-1910 Shale, medium gray, spongy-lumpy, much caving, some bentonite, some light brown chert, inoceramus prisms, pyrite nodules, calcareous.

1910-1930 Shale, medium gray-medium light gray, lumpy-fissile, pyrite nodules, a scattering of quartz grains, angular, some bentonite and inoceramus prisms.

1930-1960 Shale, medium gray-light gray, spongy, some bentonite.

1960-1970 Shale, medium gray, platy, "white specks", calcareous.

1970-2060 Shale, medium gray-light gray, spongy-compact, spongy, inoceramus fragments, bentonite.

2060-2100 Shale, light gray on fresh surface; iron staining on old surface, compact, shale, medium gray, probably caving from above.

2100-2110 Shale, dark gray, platy, some fissile, some shale as above, probably caving material.

2110-2130 Shale, medium gray, platy, second white specks, inoceramus fragments and prisms.

2130-2140 Shale, dark gray, platy, very many inoceramus fragments.

2140-2160 Shale, medium gray, platy, white specks, many inoceramus fragments and prisms.

2160-2200 Shale, medium gray, platy, lumpy, a few white specks, inoceramus fragments.

2200-2220 Shale, dark gray, platy-fissile, many inoceramus fragments, caving from above.

2220-2260 Shale, medium gray-light gray, disaggregated-lumpy, inoceramus fragments.

2260-2290 Shale, medium light gray-compact, some shale as above, the medium light gray shale has iron staining.

2290-2330 Shale, medium dark gray-light gray, mostly platy, shale, as above, poor sample, some dark gray shale contains brown plant fragments.

2330-2390 Shale, medium dark gray, platy, much caving, poor sample.

2390-2430 Shale, medium gray, platy, cavings from above.

2430-2450 Shale, as above, shale, medium light gray, compact.

2450-2520 Shale, medium dark gray, platy-fissile.

2520-2550 Shale, medium gray, platy, some caving from above, some shale, medium gray, disaggregated, lumpy.

2550-2590 Shale, medium light gray, lumpy, spongy, disaggregated, some shale as above

2590-2600 Samples missing.

2600-2650 Shale, as above, more fissile shale.

2650-2710 Sandstone, white, medium grain size, well cemented with calcite, subangular grains, much shale caving.

2710-2740 Sandstone, fine to coarse grained, round to angular, poorly sorted, shale cavings.

2740-2780 Shale, medium dark gray, platy, splintery, sandstone caving from above.

2780-2830 Sandstone, mostly medium grained, calcareous cement, grains are generally subangular, shale cavings.

2830-2860 Shale, medium dark gray, platy-fissile, shale, medium light gray, compact, soft.

2860-2890 Sandstone, picked from logs, interbedded with shale as above, much shale cavings.

2890-2930 Shale, medium gray, platy-compact, some shale, light gray, compact.

2930-3000 Sandstone, picked from logs, probably friable, sample is shale cavings.

3000-3010 Shale, medium light gray, disaggregated, sand grains, caving, medium-coarse angular-subround.

3010-3100 Shale, medium gray-medium light gray, disaggregated-lumpy, some shale contains brown plant fragments.

3100-3130 Shale, as above, sandstone, very fine grained, very light gray, consolidated.

3140-3180 Shale, as above, some is platy, contains calcite particles, the calcite includes some sand grains.

3180-3200 Shale, variegated, platy, some splintery.

3200-3230 Shale, greenish gray (5GY6/1) splintery, shale medium dark gray-medium light gray, platy, some siderite nodules, siltstone, pale brown (5YR5/2).

3230-3260 Shale, medium gray, light gray, greenish gray (5GY6/1) platy-splintery, some compact, some scattered angular quartz grains, coarse.

3260-3270 Shale as above, sandstone, very fine grained, very light gray, well cemented.

3270-3300 Shale, light gray-medium gray, platy, some is silty.

3300-3310 Shale, variegated, mostly medium dark gray-light gray, generally splintery.

3310-3320 Shale, as above, calcareous fossil fragments, occasional rounded quartz grain.

3320-3410 Shale, variegated, flaky-splintery.

3410-3470 Shale, as above, some fine grained sandstone particles, calcareous cement, friable.

3470-3520 Shale, variegated, splintery-platy.

3520-3540 Limestone, pinkish gray, sublithographic, soft, some shale as above, probably cavings.

3540-3590 Shale, variegated, flaky-platy, some splintery, a little limestone, as above, probably cavings.

3590-3620 Limestone, pinkish gray, sublithographic, interbedded with shale, as above.

3620-3650 Limestone, pinkish gray (5YR8/1) sublithographic, soft, shale cavings.

3650-3680 Shale, variegated, flaky, platy, some splintery, interbedded limestone as above.

3680-3690 Sample as above. Much caving.

3690-3740 Shale, variegated, platy-splintery, occasional limestone piece, as above. Gypsum, white, interbedded with the shales, shale is predominately medium dark gray.

3740-3760 Sample, as above with anhydrite, white-very light brownish gray replacing most of the gypsum.

3760-3790 Shale, variegated, platy-splintery, some caving material.

3790-3800 Sample, as above, with some micaceous gypsum.

3800-3830 Shale, medium gray, flaky, some shale pale reddish brown, (10R5/4), more massive.

3839-3900 Shale, medium gray, flaky-fissile.

3900-3936 Shale as above; occasional sandstone fragments, moderate reddish orange, very fine grained, calcareous.

3936- Circulation 3/4 hour. Shale as above, more sandstone as above.

3940-3960 Shale, medium dark gray, flaky, fissile.

3960-3970 Shale as above. A few fragments of sandstone, very light gray to moderate reddish brown, very fine grained; gray sandstone slightly less calcareous than reddish brown sandstone.

3970-4000 As above, occasional large pyrite fragments, moderate brown (5YR4/4), massive shale fragments, and white, fine to crystalline anhydrite.

4000-4010 Shale, sandstone as above, quartz granules, subround to sub-angular, frosted.

4010-4030 Anhydrite, white to very light gray, dense, subcrystalline, much caving.

4030-4038 Anhydrite as above, limestone, white, finely granular, sub-lithographic, pale brown secondary anhydrite replacement.

4038- Circulation 3/4 hour. Limestone as above.

4038-4046 Limestone as above, cavings.

4046- Circulation 3/4 hour. Limestone, pinkish gray to pale red, finely crystalline to crystalline, limestone as above.

4045-4055 Limestone, white to pinkish gray, finely granular, sub-lithographic, pale brown secondary anhydrite replacement.

4055-4065 Limestone, pinkish gray, subcrystalline, sublithographic.

4065- Circulation 3/4 hour. Limestone, grayish pink, grainy, argillaceous.

4065-4070 Limestone as above, much cavings.

4070-4085 Anhydrite, white to light gray, dense.

4085-4095 Limestone, pale brown, fragmental, some pale brown secondary anhydrite replacement.

4095- Circulation 50 minutes. Limestone, pinkish gray, largely replaced by crystalline, secondary, pale brown anhydrite.

4095-4100 As above.

4100-4105 Dolomite, very light gray, finely crystalline to grainy, anhydritic.

4105-4125 Dolomite, medium light gray, subcrystalline, massive.

4125-4145 Much cavings, logs and samples indicate dolomite as in 4105-4125 interval.

4145-4160 Anhydrite, light gray, subcrystalline, dense, slightly dolomitic.

4160-4173 Limestone, yellowish gray, sublithographic, subcrystalline to fine, grainy texture, pale brown anhydrite replacement.

4173- Circulation 1 hour. Limestone as above, much cavings.

4170-4190 As above, fossiliferous.

4190-4203 Anhydrite, very light gray to light gray, microsugrosic, limestone as above.

4203- Circulation 1 hour, limestone, yellowish gray, subcrystalline to microsugrosic, pale brown, secondary anhydrite replacement which gives the limestone a fragmental texture. Much cavings.

4200-4210 As above.

4210-4239 Anhydrite, light gray, subcrystalline.

4239- Circulation 1 hour, dolomitic limestone, yellowish gray, sub-crystalline to microsugrosic, small pale brown specks, probably secondary anhydrite replacement.

4240-4245 As above, much caving, good porosity.
4246- Circulation 1 hour, limestone, very light gray, fairly soft, sublithographic fine to grainy, fragmental, good porosity.

Core Chips

4246-4250 As above, fossiliferous, no oil show.
4250-4255 Limestone as above, shaley.
4255-4265 Limestone, white, subcrystalline, sublithographic.
4265-4270 Limestone as above, shaley.

Samples

4270-4255 Limestone as above.
4285-4310 Anhydrite, medium to light gray, subcrystalline.
4310-4318 Anhydrite, as above, limestone, very light gray, fine, secondary pale brown, anhydrite replacement.
4318- Circulation 65 minutes. Limestone as above.
4318-4320 As above.
4320-4360 Anhydrite, medium light gray, subcrystalline, massive.
4360-4367 Anhydrite, very light gray to light gray, as above.
4367- Circulation 1 hour, anhydrite, light gray, subcrystalline, massive.
4365-4374 Anhydrite as above.
4374- Circulation 1 hour, anhydrite as above.
4370-4390 Anhydrite as above.
4390-4405 Anhydrite, light brownish gray, crystalline, dolomitic, matrix to anhydrite, light brownish gray, subcrystalline, slightly dolomitic.
4405-4440 Anhydrite, very light gray to light gray, subcrystalline, massive.
4440-4465 Anhydrite, light gray, as above.
4465-4475 Anhydrite, very light gray, finely crystalline, a few fragments of light gray limestone, anhydrite as above, much caving.
4475-4500 Anhydrite, light gray, subcrystalline, massive, much caving.
4500-4509 Missing.
4509- Circulation 1 hour, calcitic dolomite, light gray, sublithographic, fine to fragmental, fossiliferous, much caving.
4509-4525 Missing.
4525-4535 Dolomite, yellowish gray to light gray, subcrystalline to grainy, sublithographic, some fragments have secondary anhydrite inclusions.
4535-4555 Dolomite, yellowish gray, subcrystalline to a fine grainy texture, sublithographic, secondary anhydrite crystals in some fragments, much cavings.
4555-4570 Dolomitic limestone, yellowish gray (5Y7/2), grainy to finely crystalline, argillaceous.
4570-4575 Limestone, yellowish gray (5Y7/2), fine to fragmental, sublithographic, argillaceous, dolomite, light gray, fragmental, dolomite as above.
4575-4600 Limestone, very light gray, subcrystalline, sublithographic.
4600-4625 Limestone, very light gray, subcrystalline matrix, fragmental texture.
4625-4640 Limestone, very light gray, as above, dolomite, very light gray to light gray, fine grainy, some fragmental, sublithographic.
4640-4645 Dolomite, light gray, calcitic, fine grainy texture, vuggy, limestone as above.

4645-4650 Limestone, very light gray, subcrystalline to finely crystalline, fragmental, sublithographic, vuggy, dolomite as above.

4650-4660 Limestone, very light gray, fragmental, sublithographic, pinpoint to vuggy porosity.

4660-4670 Limestone, dolomitic, as above.

4670-4675 Limestone as in 4650-4660 interval.

4675-4680 Limestone, light gray, fragmental, dolomite, medium gray, subcrystalline, hard.

4680-4695 Dolomite as above.

4695-4705 Limestone, very light gray to light gray, slightly grainy, fragmental, dolomite as above.

4705-4725 Limestone as above.

4725-4740 Limestone, very light gray to light gray, slightly grainy to finely crystalline, fragmental.

4740-4775 Limestone, white to very light gray, subcrystalline, sublithographic matrix, fragmental texture, fossiliferous.

4775-4790 Limestone, very light gray, fragmental.

4790-4800 Limestone, light gray, crystalline to fragmental.

4800-4825 Limestone, light gray to medium light gray, fragmental, fossiliferous.

4825-4870 Limestone, very light gray to medium gray, fragmental, very hard, cherty, fossiliferous.

4870-4910 Limestone, light gray to medium light gray, fragmental, fossiliferous.

4910-4925 Limestone, light gray to medium light gray, fine fragmental fossiliferous, some fragments crystalline, white, vitreous.

4925- Limestone, very light gray to light gray, grainy to fragmental, fossiliferous, much caving.

4985- Limestone as above, limestone, white, chalky, sublithographic.