

NORTH DAKOTA GEOLOGICAL SURVEY CIRCULAR NO. 241

Summary of the Amerada Petroleum Corporation - C.C. Mogen Tract 1, No. 1  
McKenzie County, North Dakota  
Well No. 1670 - Permit No. 1691

by Clarence G. Carlson  
August, 1960

The Amerada Petroleum Corporation - C.C. Mogen Tract 1, No. 1, is located in the SW, SE Section 10, T. 153N., R. 96W. McKenzie County, North Dakota. Elevations: Kelly bushing 2017: Ground level 2005.

The Amerada Petroleum Corporation - C.C. Mogen Tract 1, No. 1 well was spudded December 23, 1957, drilled to a total depth of 11,887 feet and completed as a discovery well for the Sand Creek field June 1, 1958.

Logs Run:

Laterolog-gamma ray  
Radioactivity

Core Record:

10,003-10,053  
10,476-10,501  
10,673-10,754

Tests:

DST 1; 8458-8505; Tool open 5 hours; shut in 30 minutes. Air immediately, weak blow decreasing to very weak blow in 1 hour and 20 minutes, increasing to strong blow in 1 hour and 40 minutes, strong blow for remainder of test. No gas to surface. Recovered 960 feet of muddy water cushion, 360 feet of black highly gas cut sulphurous water cushion, 180 feet of black gas cut, mud cut sulphurous water, HP 4705, IFP 755, FFP 770, 30 min, SIP 1880.

DST 2; 8530-8568; Tool open 4 hours; shut in 30 minutes, opened with weak blow decreasing to dead in 50 minutes, dead for 1 hour, weak blow for 3 minutes, dead for remainder of test. Recovered 1350 feet of water cushion, 19 feet of gas cut water cushion, 60 feet of muddy gas cut water cushion, 30 feet of gas cut mud. Pressures: IHP 4794; IFP 683; FFP 699; 30 min. SIP 1572; FHP 479.

DST 3; 8604-8655; Tool open 3 hours; shut in 30 minutes, opened with very weak blow decreasing, dead in 20 minutes; dead for remainder of test. Recovered 1,175 feet of water cushion, 180 feet of muddy water cushion, 145 feet of muddy gas cut water cushion, 185 feet of gas cut mud. Pressures: IHP 4865; IFP 530; FFP 550: 30 min. SIP 760; FHP 4840.

DST 4; 8890-8943; Tool open 5 hours; shut in 30 minutes. Opened with weak blow; weak blow continued throughout remainder of test. Recovered 1,550 feet of water cushion, 180 feet of slightly gas cut water cushion, 270 feet of muddy gas cut water cushion, 90 feet of muddy gas cut salt water, 325 feet of black gas cut salt water. Pressures: IHP 5073; IFP 965; FFP 1155; 30 min. SIP 3470; FHP 5068.

DST 5: 10,599-10,668; Tool open 3 hours; shut in 30 minutes. Opened with good strong blow, decreasing and died in 33 minutes, dead 27 minutes; by-passed fluid after 1 hour, strong blow for 1 minute, died in 3 minutes, dead for 57 minutes; by-passed fluid, strong blow for 1 minute, died in 3 minutes, dead for remainder of test. Recovered 3100 feet of water cushion, 7280 feet of drilling mud. Pressures: IHP 6156, IFP 5318; FFP 5990; 30 min. SIP 5990; FHP 6176.

DST 5-A; 10-615-10,668; Tool open 4 hours and 25 minutes; shut in 30 minutes. Opened with fair blow, increasing to strong blow continuing, gas to surface in 1 hour and 35 minutes. Water cushion to surface in 2 hours and 15 minutes. Oil to surface in 3 hours and 20 minutes; flowed an estimated 1 barrel of oil in 25 minutes and flow line plugged off. Flowline plugged for remainder of test, had 240 MCF of gas. Recovered 1750 feet of highly gas cut oil, 4% BS and mud unloaded; 920 feet of highly gas cut oil, 6% BS and mud unloaded; 645 feet of highly gas cut oil, 8% BS and mud unloaded; 185 feet of black gas cut salt water; 90 feet of gas cut mud cut salt water, 185 feet of gas cut drilling mud recovered while working gas out of D.P.; 3865 feet of drilling mud. Pressures: IHP 6151; IFP 1474; FFP 1884; 30 min. SIP 2264; FHP 6153.

DST 6; 10,672-10,754; Tool open 4 hours; shut in 30 minutes. Opened with very weak blow for 11 minutes, died, dead for remainder of test. Recovered 3,080 feet of water cushion, 120 feet of muddy water cushion, 20 feet of drilling mud. Pressures: IHP 6280; IFP 1500; FFP 1540; 30 min. SIP 2905; FHP 6155.

DST 7; 10,980-11,015; Tool open 4 hours, shut in 30 minutes. Opened with weak blow gradually decreasing in 2 1/2 hours to intermittent bubbling for remainder of test, no gas or fluid to surface. Recovered 3,500 feet of water cushion, 624 feet of salt water with crystals, 90 feet of drilling mud and salt crystals, 30 feet of salt crystals. Pressures: IHP 6600; IFP 1625; FFP 2155; 30 min. SIP 4680; FHP 5600.

DST 8; 11,038-11,069; Tool open 4 hours; shut in 30 minutes. Opened with weak blow gradually increasing to good blow for 45 minutes. Good blow for 15 minutes, gradually decreasing to weak blow in 2 hours, weak blow for remainder of test, no gas or fluid to surface. Recovered 216 feet of drilling mud, 1860 feet of water cushion, 372 feet of drilling mud, 1640 feet of water cushion, 372 feet of drilling mud, 465 feet of muddy salt water with crystals, 93 feet of salt crystals. Pressures: IHP 5647; IFP 1738; FFP 2363, 30 min. SIP 4709; FHP 5647.

DST 9; 11,720-11,766; Tool open 3 hours; shut in 30 minutes. Tool opened with very weak blow decreasing and died in 25 minutes, dead for 1 hour and 35 minutes. By-passed fluid, no blow, dead for remainder of test. Recovered 30 feet of drilling mud and salt crystals, 210 feet of fresh water cushion. Pressures: IHP 6159; IFP 1941; FFP 2000; 30 min. SIP 3185; FHP 6010.

DST 10; 11,745-11,810; Tool failed to open.

DST 10; Run 2; 11,745-11,810; misrun, no recovery.

DST 10; Run 3; 11,743-11,810 with Howco (all other tests with Johnston testers);

Tool open 55 minutes. Opened with very weak blow gradually decreasing and died in 42 minutes, dead for 13 minutes and packer gave way. Recovered 3,725 feet of water cushion, 275 feet of muddy water cushion, 1010 feet of drilling mud, no show of oil or gas. Pressures: IHP 6340; IFP 1830, FFP 1830, FHP 6270.

DST 11; 11,814-11,887; Tool open 4 hours; shut in 30 minutes. Opened with weak blow, weak blow for remainder of test, no gas to surface. Recovered 3,820 feet of water cushion, 180 feet of muddy water cushion, 180 feet of muddy salt water, 1,280 feet of black salt water, 420 feet of black sulphurous salt water, 30 feet of salt crystals. Pressure: IHP 6307; IFP 1840, FFP 2815; 30 min. SIP 5079; FHP 6269.

Completion Data:

Perforations: 10,570 to 10,588 and 10,599 to 10,672 with 4 shots per foot. Acidized with 4,000 gallons. Initial potential tests: 109 barrels of oil per day, 34% water, 44.3 degrees API gravity, GOR 1366-1.

Formation tops were determined from samples and mechanical logs, corrected to the mechanical logs. Not all formation tops are called in the following list. Colors are from the Rock Color Chart distributed by the Geological Society of America.

FORMATION TOPS

Cretaceous System	
Greenhorn formation	3692
Mowry formation	4053
Fall River formation	4445
Jurassic System	4874
Piper limestone	5540
Triassic System	
Spearfish formation	5883
Permian System	
Minnekahta formation	6238
Opeche formation	6267
Mississippian System	
Big Snowy group	6605?
Kibbey limestone	7446
Madison group, Poplar interval	7603
Ratcliffe interval	8254
Frobisher-Alida interval	8550
Bakken formation (samples)	9907
Devonian System	
Three Forks formation (samples)	10,010
Birdbear formation (samples)	10,300
Duperow formation (samples)	10,405
Souris River formation	10,767
Dawson Bay formation	11,019
Prairie Evaporite	11,150
Winnipegosis formation	11,400
Silurian System	
Interlake group	11,730

3400-3610 Shale, medium, light gray to medium dark gray, fissile.

3610-3670 Shale, medium dark gray, fissile, calcareous, "white specks".

3670-3700 Shale, as above; many Inoceramus fragments, some fragments cemented together into an argillaceous fragmental limestone.

3700-3810 Shale, medium dark gray, fissile, calcareous, "white specks", some Inoceramus fragments.

3810-4120 Shale, medium dark gray, fissile.

4120-4210 Sandstone, very light gray, very fine to fine grained, argillaceous; siltstone, very light gray; shale, medium light gray, fissile.

4210-4300 Shale, medium light gray to medium gray, fissile.

4300-4330 Sandstone, very light gray, and light olive gray, very fine to fine grained, argillaceous; shale, as above.

4330-4390 Shale, medium light gray to medium gray, fissile; sandstone, as above.

4390-4450 Sandstone, very light gray, very fine to fine grained, argillaceous with some shale, medium gray to medium dark gray.

4450-4510 Sandstone, very light gray, very fine to medium grained, sub-angular to subrounded, mostly clean quartzose, some slightly argillaceous; shale, as above.

4510-4540 Sandstone, very light gray, very fine to fine grained, sub-angular to subrounded, numerous pale yellowish brown, (10YR6/2), siderite pellets; shale, medium light gray to medium gray, soft.

4540-4620 Shale, medium light gray to medium gray, soft; sandstone as above.

4620-4640 Shale, medium light gray to medium gray, soft.

4640-4680 Shale, as above; lignite.

4680-4690 Shale, medium light gray to medium dark gray, soft, fissile and platy.

4690-4700 Shale, light brown (5YR6/4), fissile and medium light gray to medium dark gray, soft, fissile to platy.

4700-4730 Shale, light gray to very light brownish gray, lumpy, waxy and shale, medium light gray to medium gray, soft, fissile.

4730-4820 Sandstone, white to very light gray, very fine to fine grained, subangular to subrounded, slightly micaceous; shale, light gray to very light brownish gray, lumpy, waxy; shale, medium light gray to medium gray, soft, fissile.

4820-4840 Sandstone, white to very light gray, very fine to medium grained, subangular to subrounded, poorly cemented; much shale, as above.

4840-4870 Shale, medium light gray to medium gray, fissile, soft, some sandstone as above.

4870-4920 Shale, light brownish gray to very light gray, lumpy, waxy; shale, medium light gray to medium gray, fissile.

4920-5000 Shale, as above, a little sandstone, very light gray, very fine grained, argillaceous, calcareous, grading into a siltstone.

5000-5100 Shale, light gray to medium light greenish gray (5GY7/1), soft, platy to fissile, slightly calcareous.

5100-5120 Shale, as above; a little sandstone, light greenish gray (5GY8/1), very fine grained, silty, calcareous.

5120-5250 Shale, light olive gray, (5Y6/1) to greenish gray, (5GY6/1), soft, platy to fissile, calcareous, some sandstone, very light gray to light greenish gray (5GY8/1), very fine to fine grained, calcareous.

5250-5310 Limestone, very light gray to white, finely crystalline, fragmental, slightly argillaceous; much shale as above in samples.

5310-5370 Shale, greenish gray (5G6/1), to light greenish gray (5G8/1), platy to fissile, calcareous.

5370-5380 Shale, as above and light olive gray, (5Y6/1), fissile, calcareous.

5380-5430 Limestone, medium light gray, fine grained, argillaceous; shale as above.

5430-5440 Sandstone, very light gray, very fine grained, silty, argillaceous, very calcareous; shale, greenish gray to light greenish gray, platy to fissile, calcareous.

5440-5450 Shale, pale brown, (5YR5/2), lumpy, brittle, calcareous.

5450-5460 Shale, pale brown as above, a little sandstone, very light gray to grayish orange pink, very fine grained, argillaceous, calcareous.

5460-5480 Sandstone, very light gray, very fine grained, calcareous; some shale, pale brown as above.

5480-5510 Shale, pale brown (5YR5/2) to pale reddish brown (10R5/4), lumpy, calcareous; shale, greenish gray, platy, calcareous.

5510-5540 Shale, as above; a little siltstone, grayish orange pink, calcareous.

5540-5550 Limestone, light yellowish gray, finely crystalline; a little sandstone, fine grained, subangular to subrounded, clean, quartzose, weakly cemented.

5550-5560 Sandstone, light gray, very fine to fine grained, argillaceous, calcareous, some limestone, light gray, fine grained, fragmental, silty and argillaceous.

5560-5640 Limestone, very light gray to very light brownish gray, fine to medium crystalline, fragmental, some calcareous sandstone as above.

5650-5690 Limestone, very light gray to very light brownish gray, very finely crystalline, dense.

5690-5740 Limestone, very light gray to light yellowish gray, finely crystalline, dense in part, fine grained, granular in part.

5740-5750 Limestone, as above and pale red, finely crystalline, argillaceous.

5750-5770 Limestone, very light gray to light yellowish gray, finely crystalline to fine grained, granular.

5770-5790 Limestone, as above; with scattered coarse crystals of yellowish gray anhydrite.

5790-5800 Siltstone, pale red 10R6/2, slightly calcareous, argillaceous.

5800-5810 Siltstone, as above; a little shale, pale reddish brown 10R5/4, lumpy, compact, slightly calcareous.

5810-5820 Shale, moderate reddish orange 10R6/6 to light red 5R6/6, lumpy, brittle, very calcareous; some siltstone, as above.

5820-5840 Shale, moderate red 5R5/4 to pale reddish brown 10R5/4, lumpy, calcareous.

5840-5880 Shale, as above; some siltstone, moderate reddish orange to pale reddish brown, calcareous; a little colorless to white anhydrite.

5880-6080 Siltstone, moderate reddish orange, calcareous with some scattered, fine to medium, rounded, frosted sand grains; a little scattered colorless to white, anhydrite.

6080-6130 Siltstone, as above; some sandstone, grayish orange pink, 10R8/2, very fine to medium grained, silty, slightly calcareous, mostly anhydritic cement.

6130-6150 Halite, colorless to white.

6150-6170 Halite and siltstone, moderate reddish orange, very slightly calcareous.

6170-6190 Siltstone, moderate reddish orange, very slightly calcareous with numerous, fine to medium rounded, frosted sand grains.

6190-6200 Siltstone, as above; a little white anhydrite.

6200-6210 Siltstone, as above; some sandstone, grayish orange pink 10R8/2 to moderate reddish orange, very fine to medium grained, rounded frosted, anhydritic cement.

6210-6240 Siltstone, as above; some shale, pale reddish brown, lumpy.

6240-6260 Dolomite, pale red, 10R6/2, finely crystalline, granular, silty.

6280-6310 Shale, moderate reddish orange to pale reddish brown, lumpy, calcareous; siltstone, moderate reddish orange, very slightly calcareous, contains scattered fine to medium rounded sand grains.

6310-6430 Siltstone, moderate reddish orange interbedded with colorless halite.

6430-6480 Shale, moderate reddish orange to pale reddish brown, lumpy, calcareous; siltstone and halite, as above.

6480-6500 Shale, moderate reddish orange to pale, reddish brown, lumpy, calcareous; siltstone, moderate reddish orange, calcareous.

6500-6520 Siltstone, moderate reddish orange, calcareous and halite.

6520-6620 Shale, pale reddish brown to moderate reddish orange, lumpy, calcareous, some siltstone, as above.

6620-6650 Shale, variegated, mostly medium gray and medium dark gray, a little dark yellowish brown, 10YR4/2, platy to fissile, soft.

6650-6690 Shale, variegated, medium dark gray, light greenish gray 5G8/1, to greenish gray, 5G6/1, platy, calcareous.

6690-6710 Dolomite, grayish orange pink, 10R8/2, finely crystalline, granular.

6710-6730 Dolomite, as above; sandstone, grayish orange pink, 10R8/2, fine grained, dolomitic.

6730-6770 Sandstone, colorless to white, very fine to fine grained, clean, quartzose, some shale, variegated, pale red purple 5RP6/2, greenish gray, 5G6/1, and medium dark gray, platy, calcareous

6770-6810 Dolomite, grayish orange pink, 10R8/2, to grayish pink, 5R8/2, finely crystalline; some sandstone, as above.

6810-6820 Dolomite, as above and shale, moderate red, 5R5/4, platy, brittle, calcareous.

6820-6840 Dolomite, pale red, 10R6/2, medium to coarsely crystalline; dolomite, as above and shale, as above.

6840-6930 Shale, moderate red, 5R5/4 to pale reddish brown, 10R5/4 dusky yellow, 5Y6/4, platy, soft.

6930-6970 Shale, variegated, colors as above and light greenish gray, 5G8/1 and grayish red purple, 5RP4/2, platy, soft, greasy luster.

6970-7010 Shale, variegated as above and medium dark gray platy, soft, greasy luster.

7010-7040 Shale, variegated as above; with many small light olive gray, 5Y6/1, rounded nodules.

7040-7090 Shale, variegated as above; a little sandstone, medium light gray, very fine to fine grained, firmly cemented, argillaceous.

7090-7100 Shale, variegated as above; some sandstone, very light gray, very fine to fine grained, clean, quartzose.

7100-7110 Dolomite, very light brownish gray, very finely crystalline argillaceous; some shale, as above and a little sandstone, as above.

7110-7140 Dolomite, light brownish gray to medium brownish gray, very finely crystalline, argillaceous; some shale, variegated as above.

7140-7150 Dolomite, light gray to light brownish gray, fine grained, granular, argillaceous; dolomite, medium brownish gray, very finely crystalline, argillaceous; some variegated shale

7150-7160 Limestone, light yellowish gray, finely crystalline, granular, dolomitic; dolomite, as above and shale as above.

7160-7210 Limestone, medium light gray to light gray, very finely crystalline, slightly argillaceous; some limestone, light brownish gray, very finely crystalline, very argillaceous; some shale, as above.

7210-7220 Shale, variegated, mostly medium gray and medium dark gray, very slightly calcareous; some limestone, as above.

7220-7250 Dolomite, medium gray, very finely crystalline, very argillaceous; shale variegated, mostly medium dark gray, platy.

7250-7270 Shale, variegated, mostly medium dark gray, splintery; some dolomite, as above.

7270-7290 Shale, variegated as above; some sandstone, very light gray, very fine to fine grained, calcareous; a little dolomite, as above.

7290-7310 Sandstone, white to very light gray, very fine to fine grained, calcareous; shale, medium light gray to light greenish gray, lumpy, calcareous grading into a shaly limestone.

7310-7330 Shale, medium gray, lumpy, calcareous; much shale, variegated, mostly medium light gray, soft fissile, may be cave?; traces of sandstone, as above; traces of limestone, very light gray, finely crystalline.

7330-7340 Sandstone, pinkish gray to pale red, 10R6/2, very fine to fine grained, silty, calcareous; much variegated shale, splintery to platy, slightly calcareous.

7340-7400 Sandstone, pinkish gray to pale red, 10R6/2, very fine to fine and a little medium grained, calcareous, silty.

7400-7420 Sandstone, pinkish gray to pale red, 10R6/2, very fine to medium grained, rounded, frosted grains, calcareous; some siltstone, pale red, 10R6/2, calcareous.

7420-7460 Siltstone, pale red 10R6/2 to medium reddish orange, calcareous; some sandstone, as above.

7460-7470 Dolomite, pale red, 10R6/2, finely crystalline, silty, limy.

7470-7500 Limestone, light gray to very light brownish gray, very finely crystalline, dense.

7500-7510 Limestone, as above; siltstone, very light gray, calcareous.

7510-7550 Siltstone, very light gray, calcareous; some siltstone, moderate reddish orange, calcareous.

7550-7600 Siltstone, as above; some shale, medium light gray, platy, silty, calcareous.

7600-7720 Halite, colorless to white and siltstone, moderate reddish orange, calcareous.

7720-7830 Halite, colorless.

7830-7850 Limestone, light gray, fine grained, granular, silty; shale, medium light gray, soft, calcareous.

7850-7860 Halite, colorless.

7860-7870 Halite, colorless; limestone, light brownish gray, very finely crystalline and siltstone, moderate reddish orange, calcareous.

7870-7930 Halite, colorless; some siltstone, as above.

7930-7950 Siltstone, light gray, calcareous; some siltstone, moderate reddish orange, calcareous; some shale, medium light gray.

7950-7970 Limestone; light gray, fine grained, oolitic to fragmental; some anhydrite; white, some siltstone, as above.

7970-8010 Halite, colorless.

8010-8020 Dolomite, light gray, very finely crystalline, dense.

8020-8050 Limestone, light brownish gray, very finely crystalline, dense and anhydrite, white; some limestone, light brownish gray, fine to medium grained, granular.

8050-8070 Limestone, light brownish gray, oolitic in part, finely crystalline in part.

8070-8080 Limestone, light brownish gray; fine grained, fragmental with traces of white anhydrite; some limestone, medium light gray, very finely crystalline, very argillaceous.

8080-8110 Anhydrite, white; some limestone, as above.

8110-8130 Halite, colorless; traces of limestone, light brownish gray, fine grained, granular.

8130-8140 Halite, colorless.

8140-8150 Halite, colorless; anhydrite, white with traces of interbedded dolomite, light brownish gray, fine grained, argillaceous, limy.

8150-8180 Anhydrite, white; some dolomite, medium light gray, finely crystalline, argillaceous.

8180-8190 Limestone, brownish gray, very finely crystalline, dense.

8190-8210 Limestone, light brownish gray to medium brownish gray, finely crystalline, dense in part, fine to medium crystalline, granular in part with a few medium to coarse crystals of anhydrite; some limestone, medium gray, finely crystalline, very argillaceous.

8210-8220 Limestone, brownish gray, cryptocryatalline, dense.

8220-8230 Limestone, medium gray, finely crystalline, very argillaceous and limestone, light brownish gray to brownish gray, fine grained, granular in part, cryptocrystalline in part.

8230-8240 Limestone, brownish gray, cryptocrystalline.

8240-8250 Anhydrite, white; limestone, as above.

8250-8260 Anhydrite, white to very light gray.

8260-8280 Limestone, medium gray, finely crystalline, very argillaceous some limestone, light brownish gray, fine grained, granular.

8280-8300 Anhydrite, white and anhydrite, very light gray, slight calcareous.

8300-8340 Halite, colorless.

8340-8350 Anhydrite, very light gray, very finely crystalline, calcareous and limestone, light brownish gray, finely crystalline, anhydritic.

8350-8360 Limestone, light brownish gray, fine grained, granular.

8360-8365 Limestone, as above; a little anhydrite, white to light gray.

8365-8375 Anhydrite, white and anhydrite; very light gray, calcareous, some limestone, light brownish gray, fine grained, granular.

8375-8385 Limestone, brownish gray, cryptocrystalline; some anhydrite, white to light gray.

8385-8405 Anhydrite, light gray, calcareous.

8405-8415 Anhydrite, as above; some limestone, light brownish gray, fine grained, granular to cryptocrystalline.

8415-8435 Limestone, brownish gray, cryptocrystalline in part, fine grained, granular in part; traces of anhydrite, white to light gray.

8435-8440 Limestone, as above; spotty stain and slight cut with  $\text{Ccl}_4$ .

8440-8445 Limestone, brownish gray, cryptocrystalline and light brownish gray, fine grained, granular.

8445-8465 Anhydrite, white to light gray, calcareous; some limestone, as above.



8465-8480 Limestone, light brownish gray to brownish gray, cryptocrystalline in part, fine grained, granular and fragmental in part.

8480-8510 Limestone, light brownish gray, fine grained, granular and fragmental.

8510-8515 Limestone, brownish gray, cryptocrystalline.

8515-8520 Limestone, light brownish gray to brownish gray, fine grained, fragmental, argillaceous and very finely crystalline dense.

8520-8555 Limestone, light brownish gray, fine grained, fragmental, argillaceous.

8555-8580 Limestone, light brownish gray, fine grained, granular in part, slightly argillaceous; some limestone, as above.

8580-8600 Limestone, light brownish gray, cryptocrystalline; some oolitic limestone partially recrystallized to a very finely crystalline limestone.

8625-8645 Limestone, light brownish gray, fine grained, fragmental in part, granular in part, some cryptocrystalline.

8645-8660 Limestone, very light brownish gray, fine grained, fragmental.

8660-8715 Limestone, as above and limestone, light brownish gray, cryptocrystalline.

8715-8840 Limestone, very light brownish gray, fine grained, fragments fossiliferous.

8840-8850 Limestone, very light brownish gray, fine grained, fragmental and fine grained, granular.

8850-8875 Limestone, very light brownish gray, fine to medium grained, fragmental, fossiliferous; a little chert, light brownish gray to light gray, fossiliferous.

8875-8943 Limestone, light gray, fine grained, fragmental, very cherty; chert, light gray, fossiliferous.

8943 Circulation 1/2 hour - limestone and chert, as above.

8943-8965 Sample mostly cavings of shale and siltstone, traces of limestone and chert, as above.

8965-8990 Limestone, light gray to light brownish gray, fine grained, fragmental; a little chert, light gray, fossiliferous some white chalky limestone.

8990-9005 Limestone, light brownish gray, fine grained, granular, argillaceous some limestone, light gray, fine grained, fragmental; a little chert, light gray.

9005-9040 Limestone, light brownish gray to light gray, fine grained, granular argillaceous in part, fine grained fragmental in part, some chert, light gray.

9040-9065 Limestone, light gray, fine grained, fragmental, very cherty, chert, light gray, fossiliferous.

9065-9075 Limestone, brownish gray, finely crystalline, very argillaceous, limestone and chert, as above.

9075-9085 Limestone, brownish gray, finely crystalline, very argillaceous; chert, medium dark gray.

9085-9095 Limestone, as above; chert, medium dark gray and limestone, light brownish gray, fine grained, fragmental.

9095-9140 Limestone, brownish gray, cryptocrystalline; limestone, light brownish gray, fine grained, fragmental, slightly argillaceous.

9140-9150 Limestone, light brownish gray, fine grained, granular in part, fragmental in part, slightly argillaceous.

9150-9165 Limestone, brownish gray, cryptocrystalline, slightly argillaceous; some limestone, as above.

9165-9230 Limestone, light gray, fine grained, fragmental, slightly argillaceous; some limestone, brownish gray, cryptocrystalline, slightly argillaceous.

9230-9260 Limestone, brownish gray to light gray, cryptocrystalline, slightly argillaceous to fine grained, fragmental fossiliferous.

9265-9375 Limestone, light gray, fine grained, fragmental, fossiliferous, slightly argillaceous.

9375-9390 Limestone, light gray, finely crystalline, fragmental, fossiliferous in part, slightly argillaceous.

9390-9405 Limestone, very light gray, fine grained, very argillaceous; some limestone, as above.

9405-9410 Limestone, light gray to light brownish gray, finely crystalline, slightly fossiliferous, fragmental, slightly argillaceous; a little very light gray limestone, as above.

9410-9490 Limestone, very light gray, fine grained, granular, very argillaceous some limestone, light gray to light brownish gray, as above.

9490-9655 Limestone, light brownish gray to light gray, cryptocrystalline, argillaceous; some very light gray limestone, as above.

9655-9660 Limestone, as above; a little shale, brownish gray to brownish black, platy.

9660-9715 Limestone, light brownish gray to light gray, finely crystalline, argillaceous; some limestone, very light gray, fine grained, granular, fragmental in part, argillaceous.

9715-9725 Limestone, as above; a little shale, brownish gray, platy to fissile.

9725-9815 Limestone, as above.

9815-9825 Limestone, as above; shale, brownish gray to brownish black, platy.

9825-9905 Limestone, light brownish gray to light gray, very finely crystalline argillaceous, some limestone, very light gray, fine grained, argillaceous.

9905-9910 Limestone, as above; shale, brownish black to dark gray, platy.

9910-9945 Shale, brownish black to grayish black.

9945-9950 Limestone, very light gray, fine grained, granular; shale, as above.

9950-9955 Limestone, very light gray to light brownish gray, fine grained, granular, silty, argillaceous; a little sandstone, white, very fine grained, calcareous.

9955-9965 Siltstone, very light brownish gray, very fine grained, sandy calcareous; a little limestone, as above.

9965-9985 Siltstone, as above.

9985-10010 Shale, brownish black to grayish black, platy.

10010-10015 Siltstone, light brownish gray, dolomitic interbedded with shale, light greenish gray 5G8/1.

10015-10020 Shale, light greenish gray 5G8/1, platy, very slightly calcareous.

10020-10030 Interbedded shale and siltstone, as from 10010-10015.

10030-10035 Dolomite, very pale orange 10YR8/2, fine to medium crystalline.

10035-10040 Shale, greenish gray, 5G8/1, platy.

10040-10045 Dolomite, very pale orange, 10YR8/2, fine to medium crystalline, dense.

10045-10055 Shale, light greenish gray, 5G8/1, very slightly calcareous, silty.

10055-10080 Shale all cavings, mostly medium gray shale.

10080-10085 Dolomite, very pale orange to light brownish gray, fine to medium and coarsely crystalline, silty, tight except for a few small vugs.

10085-10110 Sample nearly all cavings, mostly medium gray shale; traces of dolomite, as above.

10110-10120 Dolomite, very pale orange, cryptocrystalline; much shale cavings in samples.

10135-10140 Sample nearly all cavings, mostly medium gray shale.

10140-10155 Traces of dolomite, light brownish gray and very pale orange, fine to medium crystalline; traces of light greenish gray (5G8/1) shale; sample mostly medium gray shale cavings.

10155-10165 Dolomite, very pale orange, very fine to finely crystalline silty; some shale, light greenish gray (5G8/1) platy, calcareous.

10165-10180 Shale, light greenish gray (5G8/1), platy to lumpy, calcareous; traces of dolomite, as above.

10180-10245 Shale, moderate orange pink (10R7/4), to pale reddish brown, silty, calcareous, some dolomite, as above; sample mostly shale.

10245-10265 Shale, light greenish gray, (5G8/1), lumpy, calcareous, shale, pale reddish brown to moderate reddish orange, silty, calcareous.

10265-10275 Dolomite, light brownish gray, finely crystalline, slightly anhydritic, silty; some shale, as above.

10275-10295 Dolomite, very pale orange and very light brownish gray, finely crystalline, silty; some shale, light greenish gray (5G8/1), lumpy, calcareous.

10295-10305 Dolomite, as above; some limestone, white, chalky; some shale as above.

10305-10325 Dolomite, light brownish gray, fine to medium crystalline, granular, limy, some dolomite, as above; much shale cavings.

10325-10340 Limestone, light brownish gray, fine to medium crystalline, granular, argillaceous.

10340-10345 Limestone, as above; some dolomite, light brownish gray, very finely crystalline, slightly argillaceous.

10345-10355 Limestone, very pale orange to light brownish gray, very finely crystalline, slightly argillaceous; some dolomite, light brownish gray, very finely crystalline.

10360-10375 Anhydrite, very light gray to very pale orange, dolomitic, some limestone, and dolomite, as above.

10375-10395 Limestone, very light brownish gray to very light gray, very finely crystalline and fine grained, granular.

10395-10400 Limestone, light brownish gray, very finely crystalline to fine grained, granular, anhydritic.

10400-10405 Limestone, as above; some anhydrite, light gray to white, calcareous.

10405-10430 Limestone, light brownish gray, finely crystalline to fine grained, dolomitic, slightly argillaceous.

10430-10440 Limestone, as above; some limestone, light brownish gray, fine to medium crystalline, with a few scattered rounded medium quartz grains.

10440-10455 Limestone, light brownish gray to light gray, finely crystalline to fine grained, dolomitic, slightly argillaceous.

10455-10476 Dolomite, light brownish gray, fine grained, granular, limy, slightly argillaceous, limestone as above.

Core

- 10476-10481 Dolomite, brownish gray to light brownish gray, finely crystalline, some oil stain along fractures, slight cut with CCl<sub>4</sub>.
- 10481-10483 Limestone, light brownish gray, finely crystalline, with scattered medium to coarse crystals of pale brown anhydrite.
- 10483-10487 Limestone, light brownish gray, finely crystalline, granular, scattered brachiopod fragments.
- 10487-10491 Limestone, light brownish gray, finely crystalline, slightly vuggy, most of the vugs have been filled with pale brown to colorless anhydrite; some spotty oil stain.
- 10491-10501 Limestone, light brownish gray, finely crystalline, granular, some brachiopod fragments and scattered medium to coarse crystals of pale brown anhydrite.

Samples

- 10500-10515 Sample is mostly cavings of medium to dark gray shale.
- 10515-10545 Sample mostly cavings of shale, traces of limestone, light brownish gray, fine to medium crystalline, granular.
- 10545-10565 Limestone, light brownish gray, fine to medium crystalline, granular, much cavings in samples.
- 10565-10585 Dolomite, very pale orange, fine to medium crystalline, limy, granular; much cavings.
- 10585-10600 Limestone, light brownish gray, fine to medium and coarsely crystalline, granular, slightly argillaceous.
- 10600-10610 Limestone, light brownish gray, very fine to fine and medium crystalline dense in part, granular in part.
- 10610-10615 Limestone, as above and a little anhydrite, light gray to pale brown.
- 10615-10620 Dolomite, pale brown, cryptocrystalline; some limestone as above.
- 10620-10630 Limestone, light brownish gray, cryptocrystalline, dolomitic, some spotty oil staining; some limestone, fine to medium crystalline, slightly dolomitic.
- 10630-10635 Limestone, light brownish gray, fine to medium and coarsely crystalline, granular, dolomitic, grading to limy dolomite, scattered spotty oil stain.
- 10635-10640 Limestone, as above and limestone, light brownish gray, very fine to finely crystalline, dense.
- 10640-10655 Limestone, light brownish gray, very fine to finely crystalline, dense.
- 10655-10660 Limestone, as above and limestone, light brownish gray, fine to medium crystalline, granular, anhydritic.
- 10660-10668 Limestone, light brownish gray, fine to medium and coarsely crystalline, granular, anhydritic.

Core

- 10673-10674 Anhydrite, pale brown, cryptocrystalline.
- 10674-10680 Limestone, brownish gray, very finely crystalline, dense, slight spotty oil stains 674-675.
- 10680-10682 Limestone, light brownish gray, finely crystalline, granular, slight intergranular porosity.
- 10682-10692 Limestone, light brownish gray, finely crystalline, fragmental, slight intergranular porosity in part, dense in part.
- 10692-10693 Dolomite, very light gray, fine grained.
- 10693-10694 Dolomite, light brownish gray, fine grained, limy; anhydrite, pale brown cryptocrystalline.

10694-10698 Anhydrite, medium gray, cryptocrystalline.  
 10698-10699 Dolomite, very light brownish gray, finely crystalline.  
 10699-10701 Limestone, brownish gray, cryptocrystalline.  
 10701-10702 Anhydrite, medium gray, cryptocrystalline.  
 10702-10704 Dolomite, light brownish gray, very finely crystalline, dense,  
 limy.  
 10707-10710 Limestone, brownish gray, cryptocrystalline.  
 10710-10711 Dolomite, light brownish gray, fine grained, slight oil stain and  
 anhydrite white.  
 10711-10718 Limestone, light brownish gray, fine to medium crystalline with  
 scattered coarse crystals of pale brown anhydrite from 10711-  
 10712.  
 10718-10719 Dolomite, very light brownish gray, finely crystalline, granular.  
 10719-10724 Limestone, brownish gray, very finely crystalline.  
 10724-10726 Limestone, brownish gray, very fine to finely crystalline with  
 scattered coarse crystals of pale brown anhydrite.  
 10726-10727 Anhydrite, medium gray, cryptocrystalline.  
 10727-10730 Dolomite, very light gray, finely crystalline, granular,  
 anhydritic.  
 10730-10754 Limestone, brownish gray, very finely crystalline, dense.

#### Samples

10755-10770 Limestone, brownish gray, very finely crystalline, dense.  
 10770-10780 Dolomite, light brownish gray, fine to medium grained, granular;  
 some limestone as above.  
 10780-10790 Limestone, brownish gray, cryptocrystalline.  
 10790-10810 Limestone, as above, some dolomite, light gray, finely  
 crystalline, slightly argillaceous.  
 10810-10820 Dolomite, light brownish gray, fine grained, granular slightly  
 argillaceous.  
 10820-10920 Limestone, brownish gray, cryptocrystalline; some dolomite, as  
 above.  
 10920-10930 Dolomite, very light brownish gray, very finely crystalline to  
 fine grained, granular, limy.  
 10930-10950 Dolomite, as above, some limestone, brownish gray, crypto-  
 crystalline.  
 10950-10960 Limestone, brownish gray, finely crystalline to cryptocrystalline,  
 tight, some oil stain; some dolomite, as above.  
 10960-10970 Dolomite, brownish gray, cryptocrystalline.  
 10970-10990 Dolomite, as above; some limestone, very light brownish gray,  
 finely crystalline, granular.  
 10990-10995 Limestone, light yellowish gray, fine grained, granular.  
 10995-11000 Limestone, light yellowish gray, fine grained, granular in part,  
 very finely crystalline in part.  
 11000-11010 Limestone, light yellowish gray, fine grained, fragmental and  
 granular dolomitic.  
 11010-11015 Limestone, brownish gray, cryptocrystalline, slightly dolomitic,  
 some limestone, as above.  
 11015-11030 Limestone, light yellowish gray, fine grained, granular and fine  
 to medium crystalline, dolomitic.  
 11030-11040 Dolomite, light yellowish gray, fine to medium crystalline, dense,  
 slightly limy and dolomite, brownish gray, fine to medium  
 crystalline, dense.  
 11040-11069 Dolomite, brownish gray, fine to medium and coarsely crystalline,  
 slight vuggy porosity, otherwise tight.

11080-11100 Dolomite, brownish gray, fine to medium and coarsely crystalline slight vuggy porosity, some oil stain, a very slight cut with Ccl<sub>4</sub>.

11100-11150 Limestone, brownish gray, cryptocrystalline.

11150-11200 Shale, pale yellowish brown (10YR6/2) silty and halite, colorless.

11200-11320 Halite, colorless with traces of shale, moderate reddish orange, silty.

11320-11360 Salt, colorless; some shale, moderate reddish orange, silty.

11360-11400 Shale, moderate reddish orange, slightly calcareous; some salt.

11400-11410 Salt, colorless.

11410-11450 Limestone, brownish gray, cryptocrystalline and limestone, light brownish gray, fine grained, granular.

11450-11470 Limestone, brownish gray, very finely crystalline, fragmental, and limestone, light brownish gray, fine grained fragmental.

11470-11480 Salt, colorless.

11480-11530 Limestone, light brownish gray to brownish gray, finely crystalline, fragmental, fossiliferous.

11530-11540 Limestone, as above; some salt.

11540-11580 Limestone, brownish gray to light brownish gray, very finely crystalline; fragmental.

11580-11610 Limestone, as above and dolomite, very light brownish gray, microsucrosic, argillaceous.

11610-11660 Limestone, brownish gray, cryptocrystalline.

11666 Circulation - Dolomite, very pale orange to moderate reddish orange (10R6/6) microcrystalline.

11670-11680 Limestone, brownish gray, very finely crystalline, very argillaceous.

11685-11705 Limestone, brownish gray, very finely crystalline, dense; some shale, moderate reddish orange, lumpy, slightly calcareous.

11705-11715 Dolomite, moderate orange pink (10R7/4) to moderate reddish orange (10R6/6) very finely crystalline.

11715-11725 Salt, colorless, some shale, moderate reddish orange, slightly calcareous.

11725-11730 Dolomite, pale red (10R6/2) to grayish red (10R4/2), finely crystalline, argillaceous.

11730-11735 Dolomite, as above and limestone, very pale orange, crypto-crystalline.

11735-11740 Dolomite, very pale orange to very light brownish gray, crypto-crystalline, limy.

11740-11750 Limestone, light yellowish gray, fine grained, fragmental to very finely crystalline; some oolitic with a very finely crystalline matrix.

11750-11755 Limestone, light yellowish gray, oolitic with a very finely crystalline, matrix in part, fair porosity in part, dolomitic.

11755-11760 Limestone, oolitic as above; some dolomite, very light gray, cryptocrystalline, limy.

11760-11765 Dolomite, very light gray to very pale orange, very finely crystalline, limy; some limestone, oolitic, dolomitic as above.

11766 Circulation - Dolomite and limestone as above.

11766-11780 Dolomite, very pale orange, very finely crystalline, limy; much cavings of moderate reddish orange shale and siltstone.

11780-11795 Dolomite, very light gray, very fine grained, granular, good intergranular porosity; some limestone, light yellowish gray, oolitic with a very finely crystalline, matrix.

- 11795-11820 Limestone, very light gray to light yellowish gray, oolitic and pelletoidal with the pores partially filled with a finely crystalline matrix, dolomitic, traces of slight cut with  $\text{Ccl}_4$ .
- 11820-11825 Sample mostly salt cavings.
- 11825-11887 Limestone, very light gray to light yellowish gray, oolitic and pelletoidal with some finely crystalline matrix; some dolomite, light yellowish gray, fine grained, granular, limy; scattered spotty stains and slight cut with  $\text{Ccl}_4$  from oolitic limestone.