

NORTH DAKOTA GEOLOGICAL SURVEY CIRCULAR NO. 208

Summary of the Amerada Petroleum Corporation - Clifford Hanson #3
Mountrail County, North Dakota
Well No. 355 - Permit No. 371

by Dan E. Hansen
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The Amerada Petroleum Corporation - Clifford Hanson #3 is located 2080 feet from the south line and 604 feet from the west line of Section 18, T. 158N., R. 94W., Mountrail County, North Dakota. The elevation is 2339 K.B.

The Amerada Petroleum Corporation - Clifford Hanson #3 was spudded August 11, 1953, drilled to a total depth of 12,806 feet, plugged back to 8234 feet and completed as a Madison producer in the Tioga field February 10, 1954. The well was reworked starting September 8, 1955 and recompleted in the Madison by September 24, 1955.

Logging Record:

Radioactivity:	run one 0-10,591	10/26/53
	run two 10,550-12,805.5	1/3/54
Microlaterolog:	run one 8278-12,800	1/3/54
Laterolog:	run two 8278-12, 807	1/3/54

Coring Record:

Core #1 11,387-11,495 (recovered 58')
Core #2 12,570-12,628 (recovered 56')
Core #3 12,628-12,666 (recovered 32 1/2')
Core #4 12,666-12,690 (recovered 16')
Core #5 12,690-12,748 (recovered 58')
Core #6 12,748-12,756 (recovered 58')

Drill Stem Tests:

DST #1: 9913'-10,020': Four hour test, 4 1/2" drill pipe, 1/2" opening in tool, 3000' water cushion, opened tool, air immediately, strong blow of air throughout test, no gas to surface, closed tool for 15 minutes. Tools bottom hole pressure, pulled up to 8130' and reversed out. Recovered 41 barrels water cushion, 56 barrels brownish black heavily sulphur gas cut congealed oil in tank. Corrected gravity 36.0. 468' of heavily gas cut very slightly oil cut (under 1% oil), salt water in drill collars. Recovered below reverse out sub. IHP 5710#, FHP 5400#, IFP 1700#, FFP 3700#, BHP 4500#.

DST #2: 11,375'-11,445': 53 minute test, 4 1/2" drill pipe, 3445' water cushion, 5/8" opening in tool, opened tool, received very weak blow in three minutes and continued for 45 minutes, packers failed, reset packers would not hold. Recovered 4345' of fluid as follows. 3445' of fresh water cushion, 360' of slightly muddy salt water, water tested 325,000 PPM salt, 540' of drilling mud, no show of oil or gas. IHP 6285#, IFP 1465#, FFP 1560#, FHP 62515#, no BHP.

Casing Record:

Set 13 3/8" surface casing to 622 feet with 450 sacks cement, 8 5/8" casing at 8278 with 1250 sacks cement, and 5 1/2" casing at 12,802 with 1500 sacks cement. All the casing was left in the well.

Perforations:

Perforated 5 1/2" casing from 12,670'-12,720' with 21 gram, 4 shots per foot tried to acidize formation through perforations in 5 1/2" casing from 12,670'-12,720' could not break down formation. Re-perforated 5 1/2" casing from 12,670'-12,720' with 110 grain 15/32" bullets, 2.70 holes per foot. Perforated from 12,615'-12,640' with 110 grain, 15/32" bullets, 4 holes per foot tried to acidize formation through perforation from 12,670'-12,720' and 12,615'-12,640'. Pumped 9 barrels acid into formation with 7000# maximum pressure, reversed out acid. Spotted 25 sacks cement plug from 12,615'-12,500'.

Perforated 5 1/2" casing from 12,442'-12,474' with 110 grain 15/32" bullets. Acidized formation through perforation in 5 1/2" casing from 12,442'-12,474' with 2000 gallons acid. Flowed approximately 21 barrels load oil in 4 3/4 hour. Swabbed 17 1/2 hour. Recovered 28.79 barrels of fluid (load oil and acid water). Spotted 35 sacks cement plug from 12,490'-12,305'.

Perforated 5 1/2" casing from 12,265'-12,295' and 12,195'-12,245' with 110 grain 15/32" bullets, 4 holes per foot. Acidized formation with 2000 gallons acid through perforations in 5 1/2" casing from 12,195'-12,245' and 12,265'-12,295'. Turned well to tanks, packer failed. Swabbed 25 hours, recovered 214 barrels salt water no oil. Spotted 40 sacks cement plug from 10,540'-10,240'.

Perforated 5 1/2" casing from 10,220'-10,194' and from 10,155'-10,120'. Acidized formation through perforation in 5 1/2" casing from 10,220'-10,194' and 10,155'-10,120' with 2000 gallons acid. Swabbed 21 hours, recovered load oil and 67.55 barrels salt water. Set cast iron retainer at 10,105'. Squeezed 60 sacks cement into formation.

Perforated 5 1/2" casing from 9925'-9970' with 180,110 grain 15/32" bullets, 4 holes per foot. Acidized formation through perforation from 9925'-9970' with 2000 gallons of acid. Flowed 3 hours. Received 39 barrels load oil and 3 barrels acid water. Well died. Swabbed 14 1/2 hours. Recovered 121.24 barrels salt water and 51.92 barrels oil. Set cement retainer at 9910'. Squeezed formation through perforation in 5 1/2" casing from 9925'-9970' with 100 sacks cement.

Perforated 5 1/2" casing from 9920'-9945' with 100-15/32" 110 grain bullets. Acidized formation through perforation from 9920'-9945' with 2000 gallons acid. Flowed approximately 32 barrels load oil and died. Swabbed 25 1/2 hours. Recovered 35.89 barrels oil, 292.34 barrels salt water. Spotted 50 sacks cement plug from 9770'-9470'.

Perforated 5 1/2" casing from 9440'-9460' with 80-15/32" 110 grain bullets, 4 shots per foot. Acidized with 2000 gallons acid through perforation from 9440'-9460'. Turned well to pit flowed approximately 5 barrels back and died. Swabbed 2 hours. Recovered 20.16 barrels load oil. Swabbed well to pit for 11 hours. Swabbed acid water and BS, swabbed well to tanks. Recovered 3.04 barrels load oil, 9.14 barrels BS and drilling mud. Set cast iron cement retainer at 8400'. Squeezed 20 sacks cement retainer, spotted 35 sacks cement plug from 8400'-8220'.

Perforated through 5 1/2" and 8 5/8" casing from 8160'-8218' with 232-1/

2" - 35 gram jet shots. Acidized formation through perforation from 8160'-8218' with 2000 gallons acid. 9 1/2 hours flowing, recovered 144 barrels load oil, 10 barrels BS and acid water. Acidized formation through perforation in 5 1/2" and 8 5/8" casing from 8160'-8218' with 6000 gallons etching acid. Flowing and test well 3 1/2 hours. Recovered 43 barrels new oil, 34 barrels load oil, 12 barrels BS and acid water.

Completion Test Data:

Set 8218' of 2 3/8" tubing. Perforated from 8160'-8218' and acidized with 8000 gallons acid. Plug back depth 8234. 18/64" adjustable choke, FP on tubing 900#. GOR 809, 41.3 gravity, 550 BOD net, plus 5% water. Completed February 10, 1954.

Transporter: Service Pipe Line Company.

Workover Data:

Rigged up workover tools 9-8-55. Tested. Set bridge plug at 8147' and cemented from 8147'-8138'. Perforated 5 1/2" and 8 5/8" casing from 8094'-8120' with 4 shots per foot, set tubing at 8121 with packer at 7620 and acidized with 2000 gallons; flowed 320 barrels new oil, 26 barrels load oil, 52 barrels water in 24 hours on 17/64" choke, TP 700#. Grind out 19% water; flowed 195 barrels oil, 37 barrels water in 24 hours on 12/64" choke, TP 800.

Formation tops were determined from samples and mechanical logs, and corrected to the mechanical logs. Obscure formation tops were not picked. Colors were taken from the Goddard, et. al., 1951 Rock Color Chart distributed by the Geological Society of America New York, N.Y.

FORMATION TOPS

Cretaceous System	
Pierre formation	1728
Greenhorn formation	4127
Mowry formation	4447
Basal Cretaceous sandstone	4831
Jurassic System	
Swift formation	5219 (?)
Rierdon formation	5602
Piper Limestone	5921
Triassic System	
Spearfish formation	6170
Pennsylvania System	
Amsden	6561
Mississippian System	
Big Snowy group	6610 (?)
Kibbey lime	7155
Charles formation	7300
Nesson pay equivalent	8086
Englewood formation	9328
Base of lower Englewood shale marker	9441
Devonian System	
Lyleton formation	9512 (?)
Nisku formation	9645

Duperow	9768
Souris River	10,274
Dawson Bay	10,548
Prairie Evaporites	10,714
Ashern	11,359
Silurian System	
Interlake group	11,374
Ordovician System	
Upper Stony mountain	12,367
Lower Stony Mountain	12,502
Red River formation	12,558

0-4000	No samples.
4000-4050	Shale medium dark gray to dark gray. Small amounts of dark gray shale with "white specks," calcite prisms, and medium gray shale.
4050-4110	Shale, medium dark gray to dark gray with small amounts of medium gray shale.
4110-4220	Shale, as above. With small amounts of shale containing "white specks" and a trace of light gray fragmental limestone.
4220-4320	Shale, medium dark gray to dark gray, calcareous, "white specks" and fragmental limestone.
4320-4470	Shale, medium dark gray and medium gray. Traces of calcareous shale and fragmental limestone.
4470-4900	Shale, medium dark gray and medium gray, silty. Light gray silt and very fine-grained sandstone, soft, clay indurated at 4660-4680.
4900-5170	Shale, as above. Traces of fine-grained white and light gray sandstone.
5170-5250	Shale, as above. Traces of coarse, angular quartz grains. Poor samples.
5250-5300	Shale, medium dark gray. Small amounts of fine grained, white and light gray, quartzose sandstone and loose, coarse, quartz grains. All fragments of shale are well rounded. Poor samples.
5300-5350	Shale, medium dark gray. Traces of fine-grained, quartzose sandstone, glauconitic in part and greenish gray shale.
5350-5440	Shale, as above. With splintery, greenish gray and silty light olive gray to light gray shale. Traces of fine grained, quartzose sandstone.
5440-5580	Shale, greenish gray, splintery. With light olive gray to light gray silty shale. Small amounts of fine-grained, white, calcareous quartzose sandstone, partly glauconitic or brownish stained. Large amount of sandstone from 5470-5490.
5580-5620	Shale, as above. Small amounts of shell fragments, carbonaceous streaked and crinoid stem fragments. Traces of quartz grains.
5620-5750	Shale, greenish gray. Small amounts of dark gray shale. Small amounts of light gray limey shale.
5750-5810	Shale, greenish gray, splintery; reddish brown, calcareous; and variegated brown and greenish gray. Limestone, fragmental to sublithographic, light gray and very light brownish gray. Small amounts of calcareous, very fine-grained sandstone.
5810-5880	Shale, greenish gray splintery, pale brown, and light olive gray. White to light gray and very light brownish gray, traces of oolites and shell fragments from 5830-5850 and arenaceous in part.

5880-5950 Shales, as above. Small amount of light gray and very light brownish gray, fragmental limestone, arenaceous from 5930-5950.

5950-6060 Limestone, very light gray, dense, sublithographic.

6060-6100 Shale, reddish brown with small amounts of limestone, pinkish gray to light gray, sublithographic and white anhydrite.

6100-6160 Shale, medium gray, reddish brown and small amounts of white anhydrite and light gray limestone. Poor samples. Salt efflorescent on some of the samples.

6160-6180 Shale, dark reddish brown. Traces of white anhydrite.

6180-6300 Siltstone, pale reddish brown, grading into a very fine-grained sandstone. Traces of white anhydrite. Small amounts of medium, rounded loose quartz grains, frosted.

6300-6340 Shale and siltstone, pale reddish brown.

6340-6360 Shale and siltstone, as above. Much dark gray, greenish gray, light gray shales and traces light gray limestone. Poor samples.

6360-6430 Siltstone, pale reddish brown and fine to medium grained quartzose sandstone also pale reddish brown.

6430-6510 Sandstone, very fine-to medium-grained, rounded, pale reddish brown. Siltstone, as above.

6510-6520 Shale, medium dark gray, slightly calcareous.

6520-6560 Sandstone, pale reddish brown, fine-to medium grained, rounded, frosted quartz grains. Siltstone, as above.

6560-6580 Dolomite, pale red and pinkish gray, dense, argillaceous.

6580-6600 Dolomite, pinkish gray, vuggy porosity, fine crystalline.

6610-6620 Dolomite, pale red, fine crystalline, dense.

6620-6640 Dolomite, pale red and white. Much medium gray and greenish gray shale. Medium amounts of pale red siltstone. Poor samples.

6640-6710 Shale, moderate red, splintery with light brown and very light gray massive shale mottled with moderate red.

6710-6760 Shale, dark reddish brown, grayish red, and grayish red purple, splintery.

6760-6790 Shale, as above, with fragments of fine-to medium-grained, pale red to very light gray quartzose sandstone. With traces of iron carbonate-siltstone "pellets".

6790-6830 Shale, dark gray to black, splintery. With small amounts of fragments of medium to dark gray, calcareous siltstone. Traces of pyrite. Much coal in the samples from 6820-6830.

6830-6880 Poor samples. An admixture of dark gray shales, as above; medium gray and silty greenish gray shales, and grayish red, pale red, and dark reddish brown shales splintery. Also traces of pale red siltstone.

6880-6910 Shale, medium gray, calcareous, small amount of greenish gray shale. Shales also as above.

6910-6930 Shale, as above and light gray fragmental limestone.

6939-6960 Shales, as above. Traces of limestone as above.

6960-7010 Shale, varicolored, grayish red purple, black, pale red, light olive gray, and yellowish gray, greenish gray, all splintery.

7010-7170 Shale, as above. With pale red, very-fine-to medium-grained sandstone, quartzose, slightly calcareous.

7170-7180 Shale, sandstone, as above. With much white gypsum and anhydrite.

7180-7220 Limestone, dolomitic, light brownish gray, dense, very-fine-grained, crystalline to sublithographic. Anhydritic at 7180-7190.

7220-7330 Sandstone, pale red, very-fine-grained, quartzose, silty, calcareous. Small amounts fine-medium-grained. Shales, as above, but chiefly pale red. Fair amount of very light brownish gray calcareous, "silt pellets" at 7290-7300.

7330-7420 Samples, as above. Small amount of white to light gray anhydrite.

7420-7450 Sample, missing.

7450-7480 Anhydrite, white to light gray and shales, as above.

7480-7510 Sandstone, very light brownish gray, fragmental, argillaceous, fine-grained, very calcareous. Pale red and medium gray shales. Much anhydrite, as above.

7510-7530 Anhydrite, white to very light gray, shales as above.

7530-7540 Sample missing.

7540-7550 Sandstone, light brownish, argillaceous, very-to fine-grained, very calcareous. Anhydrite and shales as above.

7550-7560 Anhydrite, very light gray, dense to white.

7560-7590 Anhydrite, as above, medium gray shale, moderate orange pink shale.

7590-7600 Limestone, light brownish gray, dense, very-fine-grained, granular, argillaceous and medium gray, calcareous shale.

7600-7640 Cave, red and black splintery shale, anhydrite, and traces limestone, as above.

7640-7660 Limestone, brownish gray, dense, very-fine-grained to sub-lithographic, slightly argillaceous.

7660-7670 Anhydrite, light gray, argillaceous, dense, very-fine-grained. Limestone, as above.

7670-7720 Anhydrite, white to very light gray, dense, crystalline, fine-grained. Light gray shale.

7720-7730 Limestone, light brownish gray, fragmental, medium-grained oolitic and fine-grained, granular. Poor samples.

7730-7740 Cave, all shale, as above.

7740-7760 Limestone, brownish gray, slightly dolomitic, dense, very-fine-grained to sublithographic.

7760-7770 Limestone, light brownish gray, fragmental, slabby, fine-medium-grained, pinpoint and vuggy porosity, Some anhydrite.

7770-7790 Limestone, light brownish gray to light gray, fine grained, grainy and slabby. Argillaceous to sublithographic. Much light gray shale.

7790-7800 Anhydrite, light gray, argillaceous, very dense.

7800-7810 Anhydrite, white, crystalline, dense.

7810-7820 Limestone, light brownish gray, fragmental, medium-grained, oolitic, argillaceous. Much anhydrite as above.

7820-7830 Very pale red shale and anhydrite, as above.

7830-7880 Cave, shales, anhydrites, and limestones, as above.

7880-7885 Anhydrite, light gray, dense, argillaceous.

7885-7890 Shale, very light gray, anhydritic.

7890-7905 Anhydrite, light gray and white, as above. Gray shales.

7905-7910 Limestone, light brownish gray, fragmental, fine-medium-grained, slabby to subcrystalline. Anhydrite as above.

7910-7915 Limestone, light gray, argillaceous, fine-grained, granular. Limestone, as above.

7915-7945 Anhydrite, white to very light gray, dense. Limestone, as above.

7945-7950 Limestone, light brownish gray, dolomitic, dense, very-fine-grained and sublithographic to slabby and subcrystalline. Anhydrite, as above.

7950-7955 Limestone, very light brownish gray, fine-grained, granular. Limestone, as above.

7955-7960 Anhydrite, light gray to white, dense.

7960-7970 Limestone, light brownish gray, slabby and subcrystalline, slightly dolomitic. Anhydrite from 7960-7965.

7970-7975 Limestone, light gray, fine-grained, granular, argillaceous. Limestone, as above.

7975-7995 Anhydrite, white to very light gray, dense.

7995-8015 Limestone, light brownish gray, slabby and subcrystalline to crystalline, very-fine-grained to medium grained. Small amounts granular.

8015-8030 Anhydrite, light gray, dense. Limestone, as above.

8030-8045 Limestone, light brownish gray, dense, very-fine-grained, crystalline to sublithographic. Anhydrite, as above. Gray chert at 8030-8035.

8045-8055 Limestone, light brownish gray, slabby, crystalline, medium-grained, and very-fine-grained, granular. Poor samples.

8055-8060 Cave, gray shale with traces of anhydrite and limestone as above.

8060-8075 Limestone, light brownish gray, slabby and crystalline, medium-grained to very-fine-grained and sublithographic. A few anhydrite inclusions and a small amount of white anhydrite.

8075-8125 Limestone, light brownish gray to medium gray, slabby and subcrystalline to crystalline and fine-grained, grainy, argillaceous.

8125-8135 Limestone, as above. With anhydrite inclusions and light gray, dense anhydrite.

8135-8145 Limestone, light gray, argillaceous, fine-grained, grainy and granular.

8145-8195 Limestone, light brownish gray, dense, slabby and subcrystalline to grainy, very-fine-grained and sublithographic. Poor samples.

8195-8200 Sample missing.

8200-8275 Limestone, light brownish gray, slabby and subcrystalline, fragmental with traces of shell fragments and fine-grained, granular. Much cave.

8275-8290 Limestone, light brownish gray, slabby and subcrystalline, fragmental, fine-coarse-grained, angular to crystalline.

8290-8295 Limestone, light brownish gray, argillaceous, fine-grained, granular.

8295-8300 Limestone, light brownish gray, fragmental, slabby and subcrystalline, fine-coarse-grained.

8300-8310 Limestone, light brownish gray, argillaceous, fine-grained, granular.

8310-8400 Limestone, very light brownish gray, fragmental, coarse-grained, slabby and subcrystalline, angular to rounded, traces of oolites.

8400-8420 Limestone, light brownish gray, fragmental, slabby and subcrystalline and coarse-grained to fine-grained crystalline and grainy, dense.

8420-8500 Limestone, very light brownish gray to very light gray, fragmental, coarse-grained, slabby to subcrystalline, angular fragments, slightly argillaceous, dense.

8500-8510 Limestone, brownish gray to dark gray, dense, very-fine-grained.

8510-8520 Limestone, very light brownish gray to very light gray, coarse-grained, angular, subcrystalline.

8520-8530 Limestone, brownish gray to dark gray, dense, subcrystalline, very-fine-grained to grainy in part, slightly argillaceous.

8530-8620 Limestone, brownish gray to dark gray, dense, fine-coarse-grained, slabby and subcrystalline, angular and rounded, to sub-lithographic.

8620-8640 Limestone, light brownish gray to medium dark gray, dense, fine-coarse-grained to sublithographic, slabby and subcrystalline, angular to rounded. Trace shell fragments.

8640-8680 Limestone, brownish gray to dark gray, dense, fine-grained, subcrystalline and grainy, to sublithographic.

8680-8690 Limestone, light brownish gray, fine-coarse-grained, slabby and subcrystalline, angular to rounded.

8690-8710 Limestone, brownish gray to medium dark gray, dense, fine-grained, subcrystalline (with some coarse-grained).

8710-8840 Limestone, medium dark gray to brownish gray, dense, fine-grained, subcrystalline to light gray, sublithographic.

8840-9320 Limestone, as above with a few fragments coarse-grained, subcrystalline.

9320-9340 Shale, black.

9340-9355 Sandstone, light, gray, slightly calcareous, fine-grained, silty and fine-medium-grained, angular to rounded, slabby and subcrystalline limestone, gray with shell fragments.

9355-9380 Sandstone, as above.

9380-9405 Siltstone and very-fine-grained sandstone, medium light gray, slightly calcareous.

9405-9440 Shale, black. Pyrite in the shale and as loose crystals.

9440-9465 Sandstone, very fine-grained and siltstone, very light brownish gray, argillaceous. Oil stained, fair to excellent CCl₄ cut. With light bluish gray shale that contains very small crystals of pyrite. Good porosity.

9465-9500 Sandstone and siltstone, as above, but carbonate and shale content increases. Still same CCl₄ cut.

9500-9515 Siltstone, dolomitic, and dolomite, very arenaceous and argillaceous, grayish orange pink, with traces of fine-grained sandstone. Good porosity.

9515-9530 Shale, pale brown, calcareous.

9530-9540 Siltstone and shale, dolomitic, light greenish gray to light gray and varying to an argillaceous dolomite, light brownish gray and light gray in color.

9540-9555 Shale, pale brown. With small amounts of samples, as above, and white anhydrite.

9555-9560 Shale, greenish gray, with inclusions of anhydrite.

9560-9565 Shale, greenish gray and pale red, inclusions and fragments of white anhydrite.

9565-9570 Shale, greenish gray, dolomitic, inclusions of white anhydrite.

9570-9580 Shale, pale brown, with fragments and inclusions of white anhydrite.

9580-9590 Shale, greenish gray, dolomitic, anhydrite inclusions.

9590-9600 Shale, pale brown, dolomitic, anhydrite inclusion.

9600-9605 Shale, greenish gray, dolomitic, inclusions of anhydrite.

9605-9615 Shale, pale brown to dusky red, calcareous.

9615-9620 Shale, greenish gray, dolomitic, inclusions of anhydrite.

9620-9630 Shale, pale brown and greenish gray, dolomitic.

9630-9635 Shale, pale brown, dolomitic.

9635-9650 Limestone, brownish gray, dense.
 9650-9655 Anhydrite, dense white to brown. With brownish gray, dense dolomitic limestone, very fine-grained.
 9655-9695 Limestone, brownish gray, very fine-grained, dense, dolomitic. Anhydrite also as above.
 9695-9745 Limestone, very dolomitic, brownish gray to light gray, dense fine to coarse crystalline to microgranular, pinpoint and vuggy porosity. Traces of shell fragments.
 9745-9775 Limestone, brownish gray, dense, fine crystalline with traces of coarse crystalline and shell fragments.
 9775-9845 Limestone, brownish gray to medium gray, dense, fine crystalline.
 9845-9855 Limestone, light to medium gray, dense, fine crystalline, dolomitic and light gray to white anhydrite.
 9855-9860 Anhydrite, light gray to white, limestone, as above.
 9860-9870 Anhydrite, as above and brownish gray to medium dark gray limestone, fine crystalline.
 9870-9880 Limestone, light gray, argillaceous, fine crystalline to microgranular.
 9880-9890 Limestone, medium to light brownish gray and anhydrite, dense, fine grained.
 9890-9900 Limestone, as above.
 9900-9905 Limestone, medium dark gray and brownish gray, dense, fine-grained.
 9905-9910 Limestone, medium light gray to light gray, dense, fine crystalline to microgranular, argillaceous.
 9910-9935 Limestone, medium dark gray to brownish gray, dense, crystalline and anhydrite light gray to white, dense.
 9935-9955 Limestone, light brownish gray, dolomitic, argillaceous, microgranular, pinpoint and intergranular porosity. Scattered oil staining. Poor CCl₄ cut.
 9955-9975 Limestone, dolomitic, dense, medium dark gray to brownish gray, fine crystalline.
 9575-9985 Limestone, dolomitic brownish gray, argillaceous, microgranular, pinpoint and vuggy porosity. Traces of coral (?) fragments.
 9985-9990 Limestone, as above, and light gray, dense calcareous shale.
 9990-10,000 Limestone, medium dark gray to brownish gray, fine crystalline, dense to medium crystalline.
 10,000-10,020 Limestone, medium gray to light gray, dense, fine crystalline.
 10,020-10,040 Limestone, medium dark gray to brownish gray, dense, fine crystalline. Small amounts of anhydrite.
 10,040-10,045 Limestone, medium gray, gray, microgranular.
 10,045-10,070 Limestone, medium dark gray (brownish) dense, fine, crystalline.
 10,070-10,075 Limestone, as above, with light gray, dense anhydrite.
 10,075-10,095 Limestone, medium gray to light gray, dense, fine crystalline and microgranular. Much anhydrite, as above.
 10,095-10,100 Limestone, as above.
 10,100-10,105 Limestone, medium dark gray (brownish), dense, fine, crystalline and light gray, dense anhydrite.
 10,105-10,110 Limestone, medium dark gray (brownish), dense, fine-to very fine-grained, crystalline.
 10,110-10,115 Limestone, medium dark gray, as above and light gray, microgranular.
 10,115-10,120 Limestone, medium dark gray, as above.

10,120-10,125 Limestone, medium gray, crystalline, fine-grained.

10,125-10,130 Limestone, medium gray to light gray, crystalline to fragmental, fine-to coarse-grained, small amount microgranular. Traces of vuggy porosity.

10,130-10,140 Limestone, light brownish gray, fine-grained, granular and small amounts of fine-medium-grained fragmental.

10,140-10,145 Limestone, medium dark gray to brownish gray, microgranular to very fine-grained crystalline.

10,145-10,155 Limestone, medium dark gray, crystalline, very fine-grained. With small amounts of light gray, microgranular limestone and dense, dark gray to very light gray and white anhydrite.

10,155-10,165 Limestone, medium gray to light gray, fine-grained crystalline to sublithographic.

10,165-10,170 Limestone, medium dark gray (brownish), fine-grained, crystalline, dense. Traces of anhydrite.

10,170-10,175 Limestone and anhydrite, as above plus light gray sublithographic limestone.

10,175-10,180 Limestone, medium gray to light gray, fine-to coarse-grained crystalline, fragmental to sublithographic.

10,180-10,190 Limestone, medium dark gray, fine-grained, dense, crystalline. Traces of anhydrite.

10,190-10,205 Limestone, medium gray to light brownish gray, microgranular and grainy, very fine-to fine-grained.

10,205-10,225 Limestone, medium gray to light brownish gray, granular, fine-to medium-grained.

10,225-10,245 Limestone, medium dark gray, dense, fine-grained, crystalline.

10,245-10,255 Limestone, medium gray, fine-to coarse-grained, crystalline and fragmental with traces of sublithographic limestone.

10,255-10,265 Limestone, medium dark gray, fine-to coarse-grained, crystalline, dense. Traces of anhydrite.

10,265-10,275 Limestone, as above, with light gray grainy to sublithographic limestone.

10,275-10,295 Limestone, medium dark gray, dense, fine-grained, crystalline. Traces of anhydrite.

10,295-10,300 Limestone, as above, and limestone, light gray, very fine-grained, grainy, argillaceous.

10,300-10,335 Limestone, light to medium grained, grainy, fine-grained argillaceous and light to medium gray calcareous shale. Medium dark gray limestone as above. Medium dark gray shale from 10,320-10,335. Traces of pale red shale from 10,310-10,325.

10,335-10,350 Limestone, medium dark gray, dense, fine-grained, crystalline, anhydritic.

10,350-10,390 Limestone, medium dark gray to medium gray, fine-grained, crystalline with small amounts of grainy, light gray limestone, and medium-to coarse-grained crystalline and fragmental.

10,390-10,395 Limestone, medium dark gray to dark gray, very dense, fine-grained (with traces of coarse-grained), crystalline, anhydritic. With small amounts of white and light gray anhydrite fragments.

10,395-10,400 Limestone, medium gray, dense, crystalline, very, fine-grained, anhydritic. Small amounts of light gray, dense anhydrite.

10,400-10,405 Limestone, very light brownish gray, argillaceous, fine-grained, microgranular, small amounts of anhydrite.

10,405-10,415 Limestone, medium dark gray to dark gray, dense, very fine-grained crystalline argillaceous, with traces of coarse-grained crystalline, anhydritic. Traces of anhydrite fragments.

10,415-10,420 Limestone, medium gray to medium dark gray, fine-grained grainy to sublithographic, argillaceous, with small amounts of above limestone. With anhydrite.

10,420-10,425 Limestone, medium dark gray to dark gray, dense, fine-grained crystalline, with anhydrite, also argillaceous.

10,425-10,440 Limestone, medium gray, dense, fine-grained, grainy to sublithographic, argillaceous. Small amounts of limestone as above.

10,440-10,445 Limestone, medium dark gray, dense, fine-grained crystalline, anhydritic.

10,445-10,455 Limestone, medium gray, fine-grained, dense, grainy to sublithographic and very fine-grained crystalline, argillaceous.

10,455-10,475 Limestone, medium gray, fine-grained grainy to microgranular, argillaceous, and also crystalline.

10,475-10,495 Limestone, medium dark gray to dark gray, dense, very fine-to fine-grained crystalline, anhydritic, with fragments of dense anhydrite.

10,495-10,520 Shale, medium gray, very calcareous and limestone, argillaceous fine-grained grainy and sublithographic, also partly fragmental.

10,520-10,540 Dolomite, very light brownish gray, sublithographic, with vuggy porosity, to fine-grained, granular, argillaceous.

10,540-10,550 Limestone, and shale as above.

10,550-10,555 Dolomite, light brownish, very fine-to fine-grained, crystalline and microgranular.

10,555-10,625 Dolomite, brownish gray, fine-to medium-grained, granular, with vuggy and pinpoint porosity, and crystalline, dense, which is partially dark gray (brownish).

10,625-10,655 Dolomite, brownish gray to dark brownish gray, fine-grained, microgranular, some pinpoint porosity.

10,655-10,680 Limestone, dolomitic, medium gray to medium dark gray, dense, fine-grained crystalline and grainy to sublithographic.

10,680-10,685 Limestone, brownish gray, fine-grained, granular to microgranular, argillaceous.

10,685-10,690 Shale, light gray, calcareous, massive.

10,690-10,695 Sample missing.

10,695-11,080 Shale, pale red, slightly calcareous. Small amounts of apatite crystals.

11,080-11,085 Limestone, light to medium dark gray, anhydrite, dense, fine-grained and much light gray anhydrite.

11,085-11,095 Anhydrite and limestone, as above.

11,095-11,100 Limestone and anhydrite as above.

11,100-11,110 Dolomite, grayish brown, limey, fragmental to dense, lithographic, very vuggy porosity, reef-like carbonate.

11,110-11,120 Shale, medium dark gray, calcareous and medium gray limestone, sublithographic.

11,120-11,180 Shale, as above.

11,180-11,195 Shale, and limestone, as above.

11,195-11,280 Limestone, light gray to medium dark gray, dense, very fine-grained crystalline to fragmental coarse-grained and sublithographic.

- 11,280-11,355 Shale, clayey, light gray to white, calcareous and light gray limestone, very fine-grained, grainy, argillaceous. Limestone as above. Small amounts of pale red shale and white anhydrite. Poor samples from 11,320-11,355.
- 11,355-11,375 Shale, dolomitic, pale red and pale red, argillaceous dolomite.
- 11,375-11,380 Dolomite, moderate orange pink to fiery pale orange, dense, fine-grained, anhydrite inclusions.
- 11,380-11,387 Dolomite, as above, and pale red shale.

Core Chip Description

- 11,387-11,390 Dolomite, very light brownish gray, limey with anhydrite and medium dark gray dolomite, dense, very fine-grained crystalline, limey.
- 11,390-11,395 Dolomite, very light brownish gray, limey, anhydritic, fragmental, oolitic, with vugular porosity.
- 11,395-11,400 Dolomite, limey, anhydritic, dense, very light brownish gray, very fine-grained, crystalline, some vuggy porosity.
- 11,400-11,420 Dolomite, as above, and light brownish gray dolomite, dense very fine-grained, crystalline.
- 11,420-11,430 Dolomite, as above, but with much more vuggy porosity.
- 11,430-11,435 Dolomite, very light to light brownish gray, dense, very fine-grained, crystalline with some inclusions of pinkish gray dolomite.
- 11,435-11,445 Dolomite, very light brownish gray dense, very fine-grained, crystalline with fragmental medium-grained inclusions.

Core Description

- 11,387-11,389½ Dolomite, very light brownish gray to light brownish gray, anhydritic, very fine-grained microsucrosic to sucrosic, with pinpoint porosity.
- 11,389½-11,393 Dolomite, light brownish gray, dense, pinpoint porosity, very fine-grained, microsucrosic to grainy, (2') (1 ½'). Dolomite, very light brownish gray to light gray, matrix is fine-grained, grainy, argillaceous with coarse-grained rounded fragmental inclusions.
- 11,393-11,394½ Dolomite, brownish gray, vugular porosity, very fine-grained crystalline dense and fine-to medium-grained fragmental, rounded, grainy matrix with inclusions, very, coarse grained, dense crystalline dolomite. Much re-crystallization and irregular bedding.
- 11,394½-11,397 Dolomite, light to brownish gray, vuggy porosity, very fine-grained matrix, crystalline to microsucrosic. A few inclusions of coarse, fragmental dolomite.
- 11,397-11,399½ Dolomite, brownish gray, dense, very fine-grained, crystalline. Evidence of fractures, some styolite. Few inclusions of fragmental dolomite.
- 11,399½-11,402½ As above.
- 11,402½-11,403½ Dolomite, (1') as above.
- 11,403½-11,404½ Dolomite, light to very light brownish gray, dense, very fine-grained, grainy to sublithographic.
- 11,404½-11,406½ Dolomite as above.
- 11,406½-11,407½ Dolomite, brownish gray, vugular, dense, very fine-grained, crystalline matrix.
- 11,407½-11,408½ As above.

11,408½-11,410 Dolomite, light to very light brownish gray, dense, very fine-grained, grainy to sublithographic.

11,410-11,412 Dolomite, brownish gray, dense, very fine-grained, crystalline.

11,412-11,418 Dolomite, very light brownish gray, dense, very, fine-grained, crystalline. Traces of coarse, fragmental inclusions and vugular porosity.

11,418-11,425½ Dolomite, very light brownish gray, vugular, very coarse-grained, fragmental, recrystallized with matrix very fine-grained crystalline.

11,425½-11,435 Dolomite, light brownish gray, dense, very fine-grained, crystalline to sublithographic. Few inclusions of fragmental dolomite, vugular in a few bands which are brownish gray in color.

11,435-11,435½ Dolomite, purplish red, very fine-grained crystalline, dense.

11,435½-11,436¾ Dolomite, yellowish gray, dense, very fine-grained, crystalline with inclusions of coarse-grained, rounded fragmental dolomite.

11,436¾-11,438½ Dolomite, purplish red, dense, very fine-grained crystalline.

11,438½-11,445 Dolomite, light to brownish gray, dense, very fine-grained, crystalline with many inclusions of anhydrite.

Sample Description

11,445-11,560 Dolomite very light brownish gray to light pale yellowish brown very fine-grained crystalline. With occasional traces of vuggy coarse, fragment, light brownish gray dolomite. Poor samples.

11,560-11,610 Dolomite, very light brownish gray to light brownish gray, dense, very fine-grained, crystalline. With fragmental coarse-grained vugular chips of dolomite in traces of small amounts.

11,610-11,650 Dolomite, as above, except with very few traces of the vugular dolomite.

11,650-11,690 Dolomite, light brownish gray, crystalline and fragmental, very fine-grained, dense to coarse-grained, with traces of oolites a generally flattened and irregular, some vuggy porosity.

11,690-11,705 Dolomite, very light brownish gray, very fine-grained, dense, crystalline.

11,705-11,745 Dolomite, as above, with a few vugular and fragmental chips.

11,745-11,785 Dolomite, light gray and pinkish gray to very light brownish gray, very fine-grained dense, crystalline with small amount of vugular porosity.

11,785-11,810 Dolomite, light to light medium gray (with traces of pale red purple) argillaceous, dense, very fine-grained crystalline.

11,810-11,830 Dolomite, pale red purple, dense, argillaceous, very fine-grained with traces of fine-grained quartz.

11,830-12,050 Dolomite, very light brownish gray, dense, very fine-grained crystalline to microsucrosic.

12,050-12,100 Dolomite, light brownish gray, dense, very fine-grained crystalline to fine-grained microsucrosic. Anhydritic from 1250-1270.

12,100-12,150 Dolomite, brownish gray to light brownish gray, dense, crystalline, very fine-grained to fine-grained microsucrosic. Traces of white, light gray chert.

12,150-12,200 Dolomite, brownish gray to light brownish gray, dense, crystalline, very fine-grained, anhydritic.

12,200-12,370 Dolomite, brownish gray to medium dark gray, dense, crystalline, very fine-grained to sublithographic, anhydritic, with small amounts of white, light gray anhydrite from 12,250-12,365 and coarse-grained crystalline dolomite.

12,370-12,420 Dolomite, limey, argillaceous, fine-grained grainy, medium dark gray, with calcareous medium gray to dark gray shale.

12,420-12,455 Limestone, medium light gray to dark gray, fine-grained grainy to sublithographic argillaceous. With dark gray, moderately calcareous shale.

12,455-12,485 Dolomite, brownish gray, microsucrosic, limey, to very fine-grained, crystalline,

12,485-12,505 Dolomite, brownish gray, dense, very fine-grained, crystalline to sublithographic.

12,505-12,570 Limestone, medium light gray to medium dark gray, argillaceous, fragmental, coarse-grained to very fine-grained, grainy and sublithographic. Many fossil fragments.

Core Description

12,570-12,611 Limestone, brownish gray to medium dark gray, dense, very fine-grained, crystalline, a few bands of dark gray, very argillaceous limestone.

12,611-12,617 Anhydrite, dense, brownish gray to light gray.

12,617-12,623 Dolomite, light brownish gray, limey, anhydritic, very fine-grained, crystalline, evidence of bedding.

12,623-12,624 Dolomite, as above, with inclusions of anhydrite.

12,624-12,636 Dolomite, brownish gray, very fine-grained, microsucrosic to crystalline, very thin banding, argillaceous and anhydritic.

12,636-12,655 Limestone, brownish to medium dark gray, very fine-grained, crystalline with inclusions of very coarse crystalline limestone.

12,655-12,660½ Anhydrite and small amounts of shale and of limestone, brownish gray to dark gray.

12,660½-12,666 Interval missing.

12,666-12,669 Dolomite, brownish gray, anhydritic, very fine-grained crystalline to grainy argillaceous, same bedding.

12,669-12,673 Anhydrite, as above.

12,673-12,676 Dolomite, brownish gray, very fine-grained, crystalline, with a few interbedded streaks of anhydrite.

12,676-12,680½ Dolomite, brownish gray to light brownish gray, dense, very fine-grained crystalline to microsucrosic.

12,680½-12,682 Dolomite, brownish gray, dense, very fine-grained, crystalline to sublithographic.

12,682-12,690 Interval missing.

12,690-12,704 Dolomite, limey, brownish gray, to light brownish gray, very fine-grained, crystalline to microsucrosic. Traces of pinpoint porosity. Fair porosity. Much bedding with breaks along the bedding planes.

12,704-12,706½ Dolomite, light brownish gray, limey, fine-grained, granular, many bedding planes, fair porosity.

12,706½-12,710 Dolomite, light brownish gray to medium gray, dense, very fine-grained, crystalline matrix with inclusions of coarse-grained dolomite fragments, much recrystallized.

12,710-12,718½	Dolomite, very limey, light brownish gray to medium gray, fine-grained granular, thinly bedded, with coarse-grained inclusions of recrystallized fragments.
12,718½-12,723	Dolomite, very limey, light brownish gray to medium gray, dense very fine-grained crystalline inclusions in a fine-grained, granular matrix.
12,723-12,728	Limestone, brownish gray to medium gray, very fine-grained crystalline to sublithographic and fine-grained granular.
12,728-12,806	Limestone, brownish gray to medium and medium dark gray very fine-grained crystalline to dense sublithographic, and fine-grained microcrystalline. The bedding is very irregular.
12,806	Total Depth.