NORTH DAKOTA GEOLOGICAL SURVEY CIRCULAR NO. 170

Summary of the Union Oil Company of California-Arne Saari #1
Towner County, North Dakota
Well No. 100 - Permit No. 116

by Dan E. Hansen
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The Union Oil Company of California - Arne Saari No. 1, Towner County, North Dakota. Location: Center SW SE Section 35 - T. 161N., R. 68W. Elevation: 1710 Ground, 1719 K.B. Total Depth: 4499, granite test.

The Union Oil Company of California - Arne Saari No. 1 was spudded June 30, 1952; drilled to a total depth of 4499 feet, found dry and plugged August 14, 1952. Three drill stem tests were taken and five ? cores were cut. Electric, laterolog, gamma ray, and the microlog were run by Schlumberger.

Logging Record:

Schlumberger electric log - Run one, 8/11/52, 412-4500
Schlumberger laterolog -Run one, 8/12/52, 2000-4496
Schlumberger microlog - Run one, 8/11/52, 2000-4497
Schlumberger gamma ray - Run one, 8/12/52, 2000-4498

Coring Record:

#1 2090-2105, #2 2190-2200, #3 2293-2308, #4 2308-2328, #5 2485-2510

Drill Stem Tests:

DST #1 (Devonian) - Tested interval from 2469 1/2 to 2510. Open 2 hours. Shut in 15 min. Recovered 120' muddy water, 420' salt water, 120' drilling mud. Hydrostatic pressure 1100 psi, initial flow pressure 50 psi, final flow pressure 300 psi, and shut in pressure 715 psi.

DST #2 (Devonian) - Tested interval from 2534 1/2 to 2575. Open 2 hours. Shut in 15 min. Recovered 120' muddy water, 390' salt water, 30' drilling mud. Hydrostatic pressure 1070 psi, initial flow pressure 35 psi, final flow pressure 300 psi, and shut in pressure 715 psi.

DST #3 (Silurian) - Tested interval from 3275 to 3315. Open 2 hours. Shut in 30 min. Recovered 210' drilling mud, 420' saltwater. Hydrostatic pressure 1675 psi, initial flow pressure 50 psi, final flow pressure 310 psi, and shut in pressure 1175 psi.

Casing Record:

Set 10 3/4" surface casing at 412.29 feet with 172 sacks cement plus 3 sacks Calcium Chloride.

Plugging Record:

Interval Plug Set	Sacks Cement
#1 4499-4430	20
#2 3805-3735	20
#3 3330-3260	20
#4 2520-2450	20
#5 1770-1700	20

#6 445- 365	20
Top surface	20
Rathole	15

Formation tops were determined from samples and electric logs. Doubtful or obscure formation tops were not picked. Color names are from the 1948 Rock Color Chart distributed by the National Research Council.

FORMATION TOPS

Cretaceous System	
Niobrara formation	940
Greenhorn formation	1330
Dakota group sandstones	1708
Jurassic System	
Piper limestone ?	2153
Triassic System?	
"Spearfish" formation	2370
Devonian System	
"Nisku" formation	2488
Duperow formation	2563
Souris River formation	2890
Dawson Bay formation	3197
Winnipegosis formation	3289
Ashern formation	3390
Silurian System	
Interlake group	3436
Ordovician System	
Stoney Mountain formation	
Upper member	3608
Lower member	3691
Red River formation	3772
Winnipeg formation	
Shale member	4355
Sandstone member	4460
Total Depth	4499

0-40	Sand and gray silt. Sand consists of medium-coarse grained and pebbles of white and clear, subrounded to angular quartz; sub-rounded; white and yellow gray dolomite; gray chert; fragments of feldspar, quartz, and bioite; and fragments of greenstone.
40-140	Sand, as above, plus much medium gray, massive shale.
140-280	Shale, medium gray, massive, silty, spongy, with sand and silt as above.
280-770	Shale, medium gray, massive, micro-micaceous, resinous. Much cement at 410-430. Few fragments siliceous iron-carbonate at 650-800.
770-870	Shale, as above, with very light gray, biotitic bentonite. Shale also becomes lumpy and spongy.
870-960	Shale, dark gray, soft, flaky, spongy, earthy. Light gray bentonite.
960-1060	Shale, medium gray, very calcareous, massive to spongy, earthy.
1060-1340	Shale, medium gray, lumpy, massive, spongy with dark gray, flaky shale.

1340-1490	Shale, medium dark gray, massive to disaggregated, very calcareous, “white specks”. With calcite prisms and shell fragments. Globigerina.
1490-1580	Shale, medium dark gray, massive to flaky, spongy, micro-micaceous, slightly calcareous. Light gray bentonite.
1580-1730	Shale, medium gray, medium dark gray, massive to flaky, lumpy, silty. Traces of very fine-grained, calcareous cemented, light gray sandstone at 1580-1600 and 1690-1720.
1730-1830	Sandstone, white, clear grains of medium to very coarse grained, pitted, frosty to vitreous quartz, angular to rounded. Traces gray chert, pyrite. Trace of rounded anhydrite (white) fragments at 1780-1800.
1830-1840	Shale and sand. Medium gray shale, massive and granules of pitted, vitreous, angular clear quartz.
1840-1880	Shale, medium gray, flaky, lumpy, spongy and cemented, calcareous, very light gray, fine-grained quartzose sandstone.
1880-1900	Limestone, light gray, dense, crystalline to dense fragmental, fossil fragments. With medium gray shale as above. The limestone grades into calcareous fine-grained quartzose sandstone.
1900-1930	Sandstone, fine grained, very light gray, calcareous cement, quartzose sandstone with green mineral. Medium and light gray shale, as above.
1930-1960	Shale, medium to light gray shale, lumpy, spongy to massive. With small amounts of red brown calcareous shale, massive and light green bentonite.
1960-1970	Limestone, light gray, crystalline, fragmental, dense, fine-coarse-grained, carbonaceous streaked. With shale as above.
1970-2000	Shale, variegated red brown, light green gray, and medium gray, massive to flaky, slightly calcareous. Pyrite and loose, medium-coarse quartz grains. Circulation at 1972. Limestone as above, shell fragments. Circulation at 1998.
2000-2040	Shale, medium gray, non-calcareous, lumpy and spongy. Red-brown and light green-gray shale as above. Circulation at 2019, samples consist of medium gray shale, red and green gray shales, and sandy limestone to very calcareous fine-grained, light gray sandstone.
2040-2065	Shale, red brown, massive, slightly calcareous. With medium gray shale.
2065-2090	Shale, clayey, pale red gray, very calcareous, lumpy with light green gray calcareous clayey shale. With very light gray, fine, dense, limestone fragments.
2090-2090	Circulation, 30 minutes, limestone very light gray to white, fine crystalline to sublithographic. Shale as above.
Core #1	2090-2105 - (9' recovered) -1 1/2' shale, pale reddish gray silty. 2' sandstone and silt; light, yellowish-gray, very fine grained quartzose sandstone and silt. 1' limestone, light yellowish gray, dense, sublithographic. 5' shale, light green gray and pale red-gray, calcareous, massive, slightly micaceous. End of core.
2105-2155	Shale, green gray, firm, splintery, calcareous, red brown shale, same. With fragments of sandy limestone and limestone, as above. Few fragments of yellow brown silty shale. Very calcareous, very light gray clay and clayey, sublithographic, soft, limestone at 2140-2150. Trace anhydrite.

2155-2165	Limestone, pinkish gray, dense, very fine grained, sub-lithographic.
2165-2180	Limestone, light yellowish gray, very fine grained, micro-granular. Shaly interval at 2165-2170. Some anhydrite (white) at 2175 and below.
2180-2190	Limestone, light yellowish gray, fine grained, granular, dense.
Core #2	2190-2200 - (10' recovered) Limestone, light yellowish gray, dense, very fine grained to sublithographic. Quartz grains in a few streaks. End of core.
2215-2220	Sandstone, white, medium-grained, rounded, anhydrite cemented, quartzose. With red. brown calcareous shale. 30 minute circulation at 2215.
2220-2235	Limestone, light yellowish gray, very fine grained, crystalline, shaly. Small amount of red brown shale.
2235-2250	Limestone, light yellowish gray, shaly, very fine grained.
2250-2265	Shale, light greenish gray, calcareous, trace of medium grained, rounded quartz. Limestone, as above.
2265-2285	Limestone, as above, with white crystalline anhydrite, light gray shale.
2285-2290	Shale, light green gray, traces red brown, calcareous, lumpy. With anhydrite, as above.
Core #3	2293-2308 (15' recovered)
2293-2296	Anhydrite, gray shale and light yellowish gray dolomite, very fine grained. Interbedded.
2296-2299	Shale, pale red, with anhydrite.
2299-2305	Shale, light green gray, with blebs and veins of anhydrite.
2305-2308	Anhydrite, gray, with light yellow gray dolomitic limestone, very fine grained.
Core #4	2308-2328
2308-2313	Shale, gray red, with streaks of anhydrite.
2313-2315	Anhydrite, with interbedded dolomite, light yellowish gray, dense.
2315-2317	Shale, gray red, small amount of green gray shale and anhydrite streaks.
2317-2323	Anhydrite and dolomite, as above, with some interbedded red shale.
2323-2328	Anhydrite, with small streaks of gray shale and light yellowish gray, dense dolomite. End of core.
2328-2370	Anhydrite, crystalline, dense, white. With red brown massive shale and traces of green gray shale.
2370-2380	Shale, grayish red, slightly calcareous, massive, lumpy, with inclusions of anhydrite and green gray sale.
2380-2395	Silt, moderate reddish orange, slightly calcareous and fine-medium grained, subrounded-rounded, frosted, pink, clear quartz grains. Inclusions of anhydrite.
2395-2415	Silt, as above. Small amounts sand as above.
2415-2470	Silt and sand as above, much anhydrite and anhydrite cement.
2470-2485	Sand as above, plus silt and anhydrite as above.
2486-2486	Circulation 30 minutes, limestone, very pale orange, fine grained, to sublithographic, dense.

Core #5	2485 - 2510 (25' recovered)
2485-2497	Limestone, light yellowish gray to brownish gray, fine grained, granular, with anhydrite streaks and calcite filling in veins. Styolites.
2497-2503	Limestone, dolomitic, light brownish gray, fine to medium grained, granular.
2503-2504	Dolomite, light brownish gray, fine to medium grained, granular.
2504-2506	Shale, red and dolomite, light brownish gray, fine grained, alternating bands.
2506-2509	Shale, pale red and yellow gray, streaks of dolomite, as above.
2509-2510	Limestone, light brownish gray, very fine grained, dense. Anhydrite streaks.
2510-2555	Limestone, pinkish to pale yellowish brown, fine grained, granular, dense, trace of shell fragments, and dense, very fine grained limestone.
2555-2565	Shale and silt, pale reddish brown, massive, calcareous.
2565-2570	Limestone, as above. Shale as above.
2570-2590	Dolomite, light brownish gray, medium grained, granular, inter-granular porosity filled somewhat with anhydrite.
2590-2600	Shale, light red, silty. With fine medium grained, rounded quartz grains (frosted) and dense, fine grained grayish pink limestone.
2600-2610	Limestone, pinkish gray, pale red, fine grained, dense slightly vugular.
2610-2620	Limestone, grayish pink, fine grained, crystalline, dense with some medium grained crystals.
2620-2635	Limestone, dolomitic, grayish orange pink, pale red, fine grained, microsucrosic. With pale red silty shale and loose grains of fine coarse, rounded quartz.
2635-2685	Limestone, moderate orange pink, fine grained, microsucrosic to medium grained, sucrosic, dense. Traces of vugs, anhydrite inclusions.
2685-2710	Dolomite, limey, pale red, light brownish gray, fine-medium grained, granular, anhydrite filling. Intergranular and vugular porosity.
2710-2725	Anhydrite, light brownish gray to white, dense and moderate orange pink silty, calcareous shale.
2725-2745	Dolomite, limey, light brownish gray, granular, fine-medium grained, vuggy and intergranular porosity filled with anhydrite.
2745-2750	Dolomite, limey, light brownish gray, crystalline, fine grained, dense. Somewhat vuggy.
2750-2760	Anhydrite and dolomite, fine grained, pale red to light brownish gray.
2760-2800	Limestone, pinkish gray and light brownish gray, fine grained, microsucrosic to sublithographic with some fragments medium grained, granular, and fragmental. Traces of anhydrite and anhydrite filling. Some vugular and intergranular porosity.
2800-2830	Limestone, light brownish gray, fine grained, crystalline, dense, somewhat vuggy and fine - medium grained, granular, with inter-granular porosity.
2830-2860	Limestone, pinkish gray, fine grained crystalline, dense to microsucrosic, vuggy porosity.
2860-2880	Dolomite, limey, light brownish gray, crystalline, sucrosic, with inclusions of anhydrite.

2880-2900	Limestone, grayish orange pink, fine grained, crystalline, sucrosic with few grains rounded, frosted quartz grains and red staining.
2900-2910	Limestone, dolomitic, light brownish gray, fine grained, sucrosic.
2910-2915	Limestone, grayish orange pink, fine grained, crystalline, dense with red brown silty, calcareous shale.
2915-2955	Dolomite, limey, grayish orange pink, fine grained, sucrosic. With moderate reddish brown, massive calcareous shale and traces of green gray massive shale and white crystalline anhydrite.
2955-2980	Dolomite, limey, pale red, fine-medium grained, sucrosic and granular. Some anhydrite filling.
2980-2995	Limestone, dolomitic, pale red, fine grained, sucrosic. With much red brown, massive, calcareous shale. Trace green gray calcareous shale.
2995-3000	Limestone, dolomitic, pale red, fine grained, sucrosic to sub-lithographic.
3000-3055	Anhydrite, white, dense, crystalline. With red brown and medium gray massive, calcareous shale.
3055-3070	Dolomite, limey, pale red, fine grained, sucrosic, inter-crystalline porosity.
3070-3075	Limestone, grayish pink, very fine grained, crystalline to sub-lithographic.
3075-3090	Anhydrite, coarse grained, dense, crystalline. With much red brown, medium gray shale and dolomite, as above.
3090-3120	Limestone, grayish pink, pale red, fine grained, sucrosic.
3120-3150	Anhydrite, white, coarse grained, crystalline, dense. With red brown shale, massive.
3150-3155	Limestone, grayish pink, very fine grained crystalline, sub-lithographic.
3155-3190	Dolomite, pale red, fine-medium grained, sucrosic, vuggy and interstitial porosity. Trace red brown shale at 3185-3190.
3190-3250	Limestone, grayish orange pink, dense, crystalline, sub-lithographic. With traces fragmental dense limestone and gypsum. The limestone becomes less dense at 3230-3250.
3250-3275	Silt, moderate reddish orange. With dense coarse crystalline anhydrite.
3275-3310	Limestone, dolomitic, grayish orange pink, fine grained, sucrosic, porous. Anhydrite inclusions. Some pinpoint porosity.
3310-3345	Dolomite, limey, light brownish gray, fine-medium grained, granular. Vuggy and pinpoint porosity.
3345-3355	Limestone, grayish pink, dense, sublithographic to coarse grained, fragmental dense. With traces of brachiopod fragments.
3355-3375	Dolomite, limey, pale red, fine-medium grained, granular.
3375-3380	Limestone, grayish pink, fine grained to sublithographic.
3380-3390	Dolomite, pale red, fine grained, sucrosic to dense, crystalline, limey.
3390-3400	Anhydrite, dense, crystalline, and dolomite, as above.
3400-3425	Silt, grayish red. Anhydrite, dense, as above. Traces pinkish gray chert and light green gray shale.
3425-3430	Anhydrite, pinkish gray to white, dense, crystalline and very fine grained, microsucrosic, pinkish gray dolomite, limey.
3430-3490	Dolomite, pinkish gray, limey, very fine grained, microsucrosic, anhydrite inclusions. Some dense with vuggy porosity and sugary fragments extremely vuggy. Traces light green gray shale.

3490-3505	Dolomite, pinkish gray, very fine grained, microsucrosic to very dense, sublithographic, cherty.
3505-3525	Dolomite, pinkish gray, fine grained, sucrosic. With streaks of dense, microsucrosic to sublithographic, pinkish gray dolomite.
3525-3530	Silt, red brown and pinkish gray, very fine grained, dense, micro-sucrosic dolomite.
3530-3540	Dolomite, light yellowish gray, very fine grained, microsucrosic to sublithographic, vuggy and somewhat cherty.
3540-3570	Dolomite, light yellowish gray, very fine grained, microsucrosic, dense.
3570-3580	Dolomite, pale red, dense, microsucrosic to sublithographic. Trace of red brown shale.
3580-3595	Dolomite, white, grayish orange pink, dense, very fine grained, microsucrosic to sublithographic. The fragments show much solution and resultant recrystallization. Cherty.
3595-3605	Silt, moderate reddish orange and massive, red brown shale. Dolomite, as above. Trace of rounded, frosted, coarse grained quartz.
3605-3630	Dolomite, light pale red, very fine grained, microsucrosic to sublithographic. Some fragments are pale red.
3630-3645	Silt and shale, red brown. With rounded, frosted quartz grains and pale red to light gray dolomite with fine-medium quartz grains.
3645-3690	Dolomite, grayish orange pink, fine grained, crystalline, dense.
3690-3700	Limestone, medium light gray, fine grained, subcrystalline, dense, shaly, grading into coarse grained, fragmental.
3700-3770	Limestone, medium light gray, fragmental, fossil fragments (brachiopod shells), with matrix of fine grained sucrosic limestone, shaly. Bryozoan fragments. Traces light gray calcareous shale and pyrite at 3760-3770.
3770-3780	Limestone, fine grained, subcrystalline, light gray, dense.
3780-3810	Limestone, light gray to pinkish gray, very fine grained, sub-crystalline.
3810-3835	Dolomite, limey, moderate orange pink, fine grained, micro-sucrosic.
3835-3840	Limestone, very light gray, coarse grained, fragmental and fine grained subcrystalline.
3840-3885	Dolomite, pinkish gray, very fine grained, subcrystalline. With fragments having pinpoint porosity and traces of fragmental chips.
3885-3895	Dolomite, as above, except becoming microsucrosic and porous.
3895-3935	Limestone, dolomitic, light gray, pinkish gray, fine grained, subcrystalline to limey dolomite, microsucrosic to sucrosic.
3935-3960	Limestone, shaly, light gray, fragmental, coarse grained to fine grained, subcrystalline.
3960-3975	Dolomite, pinkish gray, fine grained, subcrystalline to micro-sucrosic.
3975-4025	Dolomite, grayish orange pink, fine-medium grained, sucrosic to very fine grained subcrystalline, limey. Some vuggy porosity from 4010-4025.
4025-4050	Limestone, very light gray, very fine grained, subcrystalline to small amounts medium-coarse grained, fragmental, and pinkish gray, fine grained, sucrosic, limey, dolomite. Traces residue, no cut.
4050-4065	Limestone, pale yellowish brown, dense, fine grained, crystalline.
4065-4080	Limestone, light gray, very fine grained, crystalline. With dolomite, light gray, limey, fine grained, sucrosic.

4080-4090	Limestone and dolomite, as above. With light red, waxy calcareous shale and medium gray, platy, calcareous shale. Trace bryozoan fragments.
4090-4100	Limestone, light gray, fine-medium grained, fragmental, rounded, shaly. With anhydrite filling. Medium gray shale.
4100-4195	Limestone, dolomitic, light gray, fine-medium grained, fragmental rounded to crystalline, sucrosic, shaly, porous. Traces brachiopod fragments.
4195-4285	Limestone, light gray, fine grained, shaly, subcrystalline, dense to fine-coarse grained, fragmental, shaly, dense, dolomitic.
4285-4350	Limestone, light gray, fine-coarse grained fragmental, dense, shaly to fine-grained, dense, subcrystalline. Inclusions of pyrite and greenish gray shale. Small amount of crinoid stem fragments.
4350-4450	Samples missing.
4450-4460	Shale, greenish gray, massive, platy, fissile.
4460-4470	Sandstone, fine - medium - coarse, clear, rounded loose quartz grains with about one-third the grains cemented together by a brown iron silicate.
4470-4480	Shale, sandstone, as above, plus pinkish gray, dense, sub-crystalline fine grained limestone.
4480-4495	Sandstone, light gray, white, fine-medium grained, rounded, anhydrite cemented, clear-frosted, loose quartz grains. Shale as above.
4495-4499	Sandstone, as above, with much pink to clear feldspar, quartz, biotite, and dark amphibole. Much pyrite.
4499	Total Depth.