

G E O L O G Y

PREVIOUS WORK

Geological:

As in Mereenie No. 1.

Geophysical:

As in Mereenie No. 1.

Drilling:

The nearest well drilled as a petroleum test is the Mereenie No. 1, four miles to the northeast. <sup>7NW</sup> The Mereenie No. 1 test is the discovery well for the Mereenie anticline, and flowed 11 million cubic feet of gas a day for a fourteen day period.

S T R A T I G R A P H Y

Regional Stratigraphy:

As in Mereenie No. 1.

Formations Penetrated:

Stratigraphic Table

K.B. Elevation 2529 feet

| Age        | Formation                 | Formation Top<br>K.B. | Formation Top<br>Subsea | Thickness                     |
|------------|---------------------------|-----------------------|-------------------------|-------------------------------|
| Ordovician | Upper Mereenie Sandstone  | Surface               |                         | 1085'                         |
| Ordovician | Middle Mereenie Sandstone | 1085'                 | +1480'                  | 119'                          |
| Ordovician | Lower Mereenie Sandstone  | 1204'                 | +1361'                  | 296'                          |
| Ordovician | Upper Stokes              | 1500'                 | +1065'                  | 738'                          |
| Ordovician | Lower Stokes              | 2238'                 | + 327'                  | 238'                          |
| Ordovician | Upper Stairway            | 2516'                 | + 49'                   | 192'                          |
| Ordovician | Middle Stairway           | 2708'                 | - 143'                  | 327'                          |
| Ordovician | Lower Stairway            | 3035'                 | - 470'                  | 293'                          |
| Ordovician | Horn Valley               | 3328'                 | - 763'                  | 222'                          |
| Ordovician | Upper Pacoota             | 3550'                 | - 985'                  | 840'                          |
| Ordovician | Lower Pacoota             | 4390'                 | -1825'                  | 225'                          |
| Cambrian   | Goyder                    | 4615'                 | -2086'                  | 95'<br>(penetrated thickness) |
|            | Mereenie                  | 1500'                 | (penetrated thickness)  |                               |
|            | Stokes                    | 1016'                 | 976'                    |                               |

|             |                            |
|-------------|----------------------------|
| Stairway    | 812'                       |
| Horn Valley | 222'                       |
| Pacoota     | 1065'                      |
| Goyder      | 95' (penetrated thickness) |

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Detailed Stratigraphy:

Surface - 1500' (penetrated thickness 1500')

Mereenie Sandstone.

Age: Paleozoic (Ordovician)

Surface - 1085'

Upper Mereenie Sandstone (As in Mereenie No. 1)

1085' - 1204'

Middle Mereenie Sandstone.

Description: - Interbedded Sandstone and Shale. Sandstone as for Upper Mereenie; Shale, brown, purple, red, occasionally green, silty to sandy in part. Occurs in thin but extensive beds throughout Sandstone. Sequence is characterized by silty to shale nature of Formation.

1204' - 1500'

Lower Mereenie Sandstone (As in Mereenie No. 1)

1500' - 2516' (Thickness 1016')

Stokes Shale.

Age: Paleozoic (Ordovician)

1500' - 2238'

Upper Stokes. (As in Mereenie No. 1)

2238' - 2516'

Lower Stokes. (As in Mereenie No. 1)

2516' - 3328' (Thickness 812')

Stairway Sandstone.

Age: Paleozoic (Ordovician)

(As in Mereenie No. 1)

2516' - 2708'

Upper Stairway. (As in Mereenie No. 1)

2708' - 3035'

Middle Stairway. (As in Mereenie No. 1)

3035' - 3328'

Lower Stairway. (As in Mereenie No. 1)

3328' - 3550' (Thickness 222')

Horn Valley Shale.

Age: Paleozoic (Ordovician)

Description: As In Mereenie No. 1 with deletion of basal dolomite.

3550' - 4615' (Thickness 1065')

Pacoota Sandstone

Age: Paleozoic (Ordovician - Cambrian?)

Description: The section consists of interbedded Sandstone and Shale in varying proportions but generally in the ratio 70 : 30. The top of the Pacoota is picked from samples on the dolomite that occurs approximately 30 feet above the first appearance of glauconitic Sandstone below the Horn Valley Shale sequence. The Pacoota has been divided as follows.

(From Logs and Samples)

Upper Pacoota: Interbedded Sandstone and Shale. 3550' - 4390'  
(Thickness 840')

Sandstone is generally light to dark grey, occasionally brown, fine to medium grained, occasionally coarse, siliceous, calcareous in part, usually clean and well cemented.

Sandstone occurs partly as well defined beds and partly as a mixed pattern of Sandstone and Shale patches, which are in part worm tube fillings, in a general network of black, micaceous shale. Scattered Styolites and abundant residual Hydrocarbon (around and on quartz grains) are present throughout the interval. Several glauconitic Sandstone beds occur over the interval 4030' - 4110'.

Worm tubes are scattered throughout the upper sandstone sections and some Scolithid zones are present. Shale changes from black to red, green (micaceous) below 4280'.

Lower Pacoota: Top 4390' (penetrated thickness 225')

Predominately Sandstone with some minor (thin) lenses and beds, green, brown, red, Shales. Sandstone is fine to coarse grained, light to dark grey, brown, well cemented, siliceous, calcareous in part with occasional clay cementing material occurring towards the bottom of Interval. Sandstone

is slightly quartzitic in part and contains scattered red spots of calcareous stains in the upper section.

4615' - 4710' (Total Depth)

Goyder Member (Pertacorrta Formation)

Age: Paleozoic (Cambrian)

Description: Predominately Sandstone, red-brown, occasionally white to dark grey, with minor black shale beds. Commonly medium to poorly sorted, fine to coarse grained, calcareous and abundant white clay material (barite?). Minor glauconite grains present.

RELEVANCE TO OCCURRENCE OF PETROLEUM

East Mereenie No. 1, a 4 mile stepout from Mereenie No. 1, indicated that permeabilities in the Upper Pacoota formation could be continuous over long distances on the Mereenie anticline.

Particularly significant was the presence of a gas column of approximately 1100 feet. From the produced gas, condensate could be extracted at a rate similar to that determined at Mereenie No. 1.

The well was completed before full penetration of the hydrocarbon column was achieved due to the high hydrostatic pressure being held against the gas zones. This was necessitated by the abnormal pressures in the Stairway formation higher up the hole.

Drill Stem Tests run on East Mereenie No. 1 gave aggregate production rates of 310,000 cubic feet/day from the Upper Stairway, 260,000 cubic feet/day from the Lower Stairway and 19,970,000 cubic feet/day from the Pacoota. A total of 18 drill stem tests were made on the well. The results of these tests are tabulated on pages 9, 10, 11, and 12 and the Charts are Figures 3 to 20.

POROSITY AND PERMEABILITY OF SEDIMENTS PENETRATED

Porosity and permeability of strata penetrated, were determined initially by visual examination of cores and cuttings, under the binocular microscope and recorded in sample descriptions. Core analyses were performed by

Core Laboratories and the Bureau of Mineral Resources. Results of these analyses are tabled in Appendices A(ii) and A(iii).

Porosity and permeability appears to be high in the Mereenie Sandstone from visual observation under a microscope. The microlog indicates very high permeability in the lower Mereenie Sandstone. From drilling evidence (Lost Circulation etc.) the Upper Mereenie sand appears to be subject to open fracturing under higher than normal hydrostatic pressure. The Stairway Sandstone has low porosity and permeabilities. Fracturing probably plays an important part in the permeability of this formation.

Visual observation of the Pacoota cuttings, core analysis, and test results indicates the best porous and permeable zones to be in the Upper Pacoota over the interval 3824' - 3830'. Permeability throughout the Pacoota (except for the zone mentioned above) is fair to very slight (little effective permeability can be determined in hand specimen from cores). It should be noted that porosity is often affected by secondary silicification and quartz recrystallization.

Porosity in the Pacoota formation ranges up to 14%. Permeabilities range from less than 0.1 millidarcys to 814 millidarcys (horizontal). Vertical permeabilities have been measured up to 1350 millidarcies.

CASING AND WELLHEAD DATA

Two unsuccessful attempts were made to spot a cement plug above the top permeable interval in the Pacoota Formation, prior to the running of the 7" casing.

A string of 7" casing consisting of 47 joints of Grade N.80 29 lbs/ft. Extreme line and 59 joints of Grade J.55, 26 lbs/ft., S.T. & C. with two cross-over joints, were run and cemented with the shoe at 3582 feet using 400 sacks of construction cement in a 14.7 lbs./gal. slurry. The cement was displaced with 138 barrels of mud and the plug was bumped with 1100 p.s.i.g.

The float collar, shoe joint and shoe were drilled out using a 6 $\frac{1}{2}$ " bit run on 2 $\frac{7}{8}$ ", Grade N.80 6.5 lbs./ft. E.V.E. tubing. The bit was run down to bottom and gas cut mud circulated and conditioned.

The B.O.P.'s. were removed, the tubing landing head installed, and 149 joints of 2 $\frac{7}{8}$ ", Grade N.80 tubing was run to 4660 feet and landed in the tubing landing head. The bottom 90 feet of the tubing was preperforated; a cross bar being installed across the open end of the bottom joint.

A Christmas tree consisting of two, 8 $\frac{1}{2}$ ", Series 900, flanged W.K.M. valves as master gates, a cross with two 2", Series 900, flanged W.K.M. valves as side arms, one side arm being fitted with an O.C.T. positive/adjustable bean. Above the cross a blind O.C.T. union, tapped  $\frac{1}{2}$ " A.P.I. was fitted with a  $\frac{1}{2}$ " 5000 p.s.i. working pressure needle valve.

Flow from the annulus is controlled by two, 2", Series 900, screwed W.K.M. valves. One annulus side arm being connected by 2" extra heavy line pipe to the non-beaned side arm of the tubing head.

The mud was displaced by water and the well flowed to clean. Preliminary flows in excess of 30,000,000 cubic feet of gas per day were measured. Surface shut-in pressure is 1525 p.s.i.

Final calculated open flow tests will be run on this well when high pressure testing equipment is available.