GEOLOGIC AND ENGINEERING CHARACTERIZATION OF GERALDINE FORD FIELD, REEVES AND CULBERSON COUNTIES, TEXAS - SPECIAL CORE-ANALYSIS DATA

Topical Report - 1997

By
Shirley P. Dutton
Mohammad A. Malik
George B. Asquith
Mark D. Barton
Andrew G. Cole
John Gogas
Sigrid J. Clift
Jose I. Guzman

April 1998

Performed Under Contract No. DE-FC22-95BC14936

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas

National Petroleum Technology Office
U. S. DEPARTMENT OF ENERGY
Tulsa, Oklahoma
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Prepared for
U.S. Department of Energy
Assistant Secretary for Fossil Energy

Jerry Casteel, Project Manager
National Petroleum Technology Office
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Prepared by:
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The University of Texas at Austin
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<td>Oil-Gas Relative Permeability Data</td>
<td>33-44</td>
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# Routine Core Data

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<thead>
<tr>
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<th>Geraldine Ford</th>
<th>Interval Cored</th>
<th>2.573 - 2.606</th>
<th>Division</th>
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<td>District</td>
<td>Monahans</td>
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<tr>
<td>Well</td>
<td>TXL &quot;L&quot; 2</td>
<td>Coring Fluid</td>
<td>Salt-Base Mud</td>
<td>County</td>
<td>Culberson</td>
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</table>

<table>
<thead>
<tr>
<th>Depth</th>
<th>Core No.</th>
<th>Porosity, %</th>
<th>Permeability, MD</th>
<th>Form. Factor</th>
<th>Core Water Saturation, %</th>
<th>Core Oil Saturation, %</th>
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<tbody>
<tr>
<td>2.573</td>
<td>GF-2</td>
<td>10.2</td>
<td>0.0732*</td>
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<tr>
<td>2.573</td>
<td>GF-3</td>
<td>9.84</td>
<td>0.110*</td>
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<tr>
<td>2.573</td>
<td>GF-4</td>
<td>15.6</td>
<td>1.03</td>
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<td></td>
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<tr>
<td>2.575</td>
<td>GF-5</td>
<td>14.7</td>
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<td>38.1</td>
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<td></td>
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<tr>
<td>2.575</td>
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<td>1.13</td>
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<td>2.573</td>
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<td>116</td>
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<td></td>
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<td>2.579</td>
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<td></td>
<td></td>
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<tr>
<td>2.579</td>
<td>GF-17</td>
<td>23.4</td>
<td>43.8</td>
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<td></td>
<td></td>
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<td>2.579</td>
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<td>51.4</td>
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<td>1.81</td>
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<tr>
<td>2.605</td>
<td>GF-21</td>
<td>9.07</td>
<td>1.06*</td>
<td>67.5</td>
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<tr>
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<td>8.79</td>
<td>0.0587*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Gas permeability uncorrected for gas slippage.

A - Unmounted core for oil-water relative permeability.

B - Same core as "A" mounted in lucite for gas-oil relative permeability.
AVERAGE DESATURATION EXPONENT

<table>
<thead>
<tr>
<th>FIELD</th>
<th>Geraldine Ford</th>
<th>DATA FROM</th>
<th>3</th>
<th>CORES</th>
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</thead>
<tbody>
<tr>
<td>RESERVOIR</td>
<td>Delaware Sand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WELL</td>
<td>TXL &quot;L&quot; 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPTH</td>
<td>2,575-2,599 ft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESATURATION EXPONENT</td>
<td>1.32</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: \( R/R_e \) = RATIO OF RESISTIVITY OF SAND SATURATED AT LEVEL UNDER CONSIDERATION TO RESISTIVITY OF SAND SATURATION 100%.

\[ n = 1.32 \]

\[ \frac{R}{R_e} = \]
### RESISTIVITY RATIO VS WATER SATURATION

<table>
<thead>
<tr>
<th>Field</th>
<th>Geraldine Ford</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservoir</td>
<td>Delaware Sand</td>
</tr>
<tr>
<td>Well</td>
<td>TXL &quot;L&quot; 2</td>
</tr>
<tr>
<td>Depth, ft</td>
<td>2,575</td>
</tr>
<tr>
<td>Porosity, %</td>
<td>14.7</td>
</tr>
<tr>
<td>Permeability, md</td>
<td>0.645</td>
</tr>
<tr>
<td>Core</td>
<td>GF-5</td>
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<tr>
<td>Desaturation Exponent</td>
<td>1.09</td>
</tr>
</tbody>
</table>

**Note:** \( \frac{R}{R_0} = \text{Ratio of Resistivity of Sand saturated at level under consideration to Resistivity of Sand saturated 100%}. \)

\[ n = 1.09 \]

\[ \phi = 14.7 \]
**RESISTIVITY RATIO VS WATER SATURATION**

<table>
<thead>
<tr>
<th>FIELD</th>
<th>Geraldine Ford</th>
<th>CORE</th>
<th>GP-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESERVOIR</td>
<td>Delaware Sand</td>
<td>DESATURATION EXPONENT</td>
<td>1.41</td>
</tr>
<tr>
<td>WELL</td>
<td>TXL 'L' 2</td>
<td>NOTE:</td>
<td>R/R_o = RATIO OF RESISTIVITY OF</td>
</tr>
<tr>
<td>DEPTH, ft</td>
<td>2,583</td>
<td>SAND SATURATED AT LEVEL UNDER CONSIDERATION TO RESISTIVITY OF SAND</td>
<td></td>
</tr>
<tr>
<td>POROSITY, %</td>
<td>25.2</td>
<td>SATURATED 100%</td>
<td>n = 1.41</td>
</tr>
<tr>
<td>PERMEABILITY, md</td>
<td>95.4</td>
<td>SATURATED 100%</td>
<td>n = 1.41</td>
</tr>
</tbody>
</table>

**BASIC CORE DATA-RES. ENG. LABORATORY**

BY G. F. McKenna  APPROVED W. M. Stevenson, Jr.  - 4  CORE REPORT  232
RESISTIVITY RATIO VS WATER SATURATION

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft. 2,599
POROSITY, % 26.0
PERMEABILITY, md 65.3

CORE GF-16
DESATURATION EXPONENT 1.46
NOTE: \( R/R_0 = \) RATIO OF RESISTIVITY OF SAND SATURATED AT LEVEL UNDER CONSIDERATION TO RESISTIVITY OF SAND SATURATED 100%. \( n = 1.46 \)

BASIC CORE DATA - RES. ENG. LABORATORY
BY G. P. McKenna APPROVED W. M. Stevenson, Jr.

HUMBLE OIL & REFINING CO.

232
MEASURED POROSITY VS. MEASURED FORMATION FACTOR

TXL "L" 2
Geraldine Ford, Delaware Sand

Measured Formation Factor, F

40
30
20
10
5
3

Measured Porosity, \( \phi \), percent

40 30 20 10

Humble Equation*

\[ F = \frac{0.62}{\phi^{2.15}} \]

*The Humble equation is presented for comparative purposes only and may not necessarily be the best equation for this reservoir.

Basic Core Data-Res. Eng. Laboratory
By W. D. McRae Approved W. M. Stevenson, Jr. - 6-Core Report 232

\[ IPF = 15860 + 188W \]
\[ GOR = 627; 40^\circ \text{API} \]
Drilling Mud Resistivity Measurements

Well:   TXL "L" 2
Field:  Geraldine Ford
Type Mud: Salt Base
Date Sample Obtained:  Unknown

Mud Temperature = 74.6 F
Resistivity of Mud, $R_m = 0.054$ ohmmeter at 74.6 F
Resistivity of Mud Filtrate, $R_{mf} = 0.0426$ ohmmeter at 74.6 F
Resistivity of Mud Cake, $R_{mc} = 0.102$ ohmmeter at 74.6 F
LABORATORY FLUID DISTRIBUTION CURVES

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
CORED INTERVAL 2,573-2,606 ft

DATA FROM 6 CORES
PERMEABILITY RANGE, md. 1.13 TO 115
METHOD Centrifuge, Air Kerosene

Note: Dashed lines indicate extrapolated data.
CAPILLARY PRESSURE CURVE

FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: Txl "L" 2
DEPTH, ft: 2,575

CORE: GF-6
PERMEABILITY, md: 1.13
POROSITY, %: 15.0
METHOD: Centrifuge, Air-Kerosene

CAPILLARY PRESSURE, psi

WETTING LIQUID SATURATION, percent

BASIC CORE DATA - RES. ENG. LABORATORY
BY B. J. Black APPROVED W. M. Stevenson, Jr. - 9 - HUMBLE OIL & REFINING CO.
CORE REPORT 232
### Field Data:

- **Field:** Geraldine Ford
- **Reservoir:** Delaware Sand
- **Well:** TXL "T" 2
- **Depth:** 2,583 ft

### Core Data:

- **Core:** GF-8-B
- **Permeability, md:** 116
- **Porosity, %:** 26.7
- **Method:** Centrifuge, Air-Kerosene

---

**Graph:**

- **Y-axis:** Capillary Pressure, psi
- **X-axis:** Wetting Liquid Saturation, percent

---

**BASIC CORE DATA - RES. ENG. LABORATORY**

Approved by J. S. Sheffield, W. M. Stevenson, Jr. -10-

**HUMBLE OIL & REFINING CO.**

**CORE REPORT** 232
CAPILLARY PRESSURE CURVE

FIELD
GERALDINE FORD

RESERVOIR
DELWARE SAND

WELL
TXL "L" 2

DEPTH, ft
2,583

CORE
GF-10

PERMEABILITY, md
95.4

POROSITY, %
25.2

METHOD
CENTRIFUGE, AIR-KEROSENE

WETTING LIQUID SATURATION, percent

0 10 20 30 40 50 60 70 80 90 100

CAPILLARY PRESSURE, psi

0 10 20 30 40 50 60 70 80 90 100
CAPILLARY PRESSURE CURVE

FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: TAL "L" 2
DEPTH, ft: 2,593

CORE: GP-14
PERMEABILITY, md: 24.0
POROSITY, %: 22.3
METHOD: Centrifuge, Air-Kerosene

WETTING LIQUID SATURATION, percent

CAPILLARY PRESSURE, psi

BASIC CORE DATA - RES. ENG. LABORATORY
BY S. J. Black APPROVED W. H. Stevenson, Jr.
HUMBLE OIL & REFINING CO.
CORE REPORT 232
CAPILLARY PRESSURE CURVE

FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: TXL "L" 2
DEPTH, ft: 2,599

CORE: GF-18
PERMEABILITY, md: 51.4
POROSITY, %: 25.1
METHOD: Centrifuge-Air-Kerosene

WETTING LIQUID SATURATION, percent

BASIS CORE DATA: RES. ENG. LABORATORY
BY S. J. Black
APPROVED W. M. STEVENSON, JR.
HUMBLE OIL & REFINING CO.
CORE REPORT 232
**CAPILLARY PRESSURE CURVE**

**FIELD** Geraldine Ford  
**RESERVOIR** Delaware Sand  
**WELL** TXL "L" 2  
**DEPTH, ft** 2,605  

**CORE** GF-20  
**PERMEABILITY, md** 1.81  
**POROSITY, %** 13.5  
**METHOD** Centrifuge, Air-Kerosene

---

**WETTING LIQUID SATURATION, percent**

---

**BASIC CORE DATA**  
**RES. ENG. LABORATORY**

**HUMBLE OIL & REFINING CO.**

**BY F. E. HARRELL APPROVED W. M. STEVENSON, JR. -14-**

**CORE REPORT 212**
### INJECTIVITY TEST

<table>
<thead>
<tr>
<th>FIELD</th>
<th>Geraldine Ford</th>
<th>CORE</th>
<th>GP-0</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESERVOIR</td>
<td>Delaware Sand</td>
<td>PERMEABILITY, md</td>
<td>101</td>
</tr>
<tr>
<td>WELL</td>
<td>Txl &quot;T&quot; 2</td>
<td>POROSITY, percent</td>
<td>25.9</td>
</tr>
<tr>
<td>DEPTH, ft</td>
<td>2,583</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Graph showing cumulative injection, pore volumes vs. water permeability.](image-url)

**Basic Core Data—Res. Eng. Laboratory**

By W. D. McRae  
Approved by W. M. Stevenson, Jr.  
Humble Oil & Refining Co.
INJECTIVITY TEST

FIELD       Geraldine Ford
RESERVOIR   Delaware Sand
WELL        TXL "L" 2
DEPTH, ft. 2,593

CORE       GF-13
PERMEABILITY, md. 42.7
POROSITY, percent 24.5

CUMULATIVE INJECTION, pore volumes

BASIC CORE DATA-RES. ENG. LABORATORY
BY W. D. McRae APPROVED W. M. Stevenson, JR. - CORE REPORT 232
LABORATORY WATERFLOOD SUMMARY

Field: Geraldine Ford
Reservoir: Delaware Sand
Well: TXL "L" 2
Cored Interval: 2,573 - 2,606 ft

The procedure for determining oil-water relative permeability relations in the Laboratory consists of flooding a preserved core until a minimum water saturation is reached and then waterflooding to a residual oil saturation. Occasionally, insufficient data are obtained during the waterflooding to permit the calculation of relative permeability relations. This may occur, for example, as a result of technical difficulties or because of calculation procedures which require signifcant oil production after water breakthrough. Under these circumstances, the only data obtained are the water saturation and the permeability to oil at the beginning of the waterflooding, the final oil saturation, and the permeability to water at the end of the waterflooding. These data represent the initial and final points usually found on oil-water relative permeability curves. *

Presented below for comparative purposes are those values obtained on all waterfloods, along with the number of pore volumes of water injected, and the viscosity ratio of the fluids used.

*It is pointed out that a 20-centipose oil and a 1-centipose water (approximately) were used in the waterflooding and a large number of pore volumes of water are generally injected. Injection is continued until the rate of change of oil saturation with water injected is very small or negligible, indicating that, for laboratory conditions, residual oil has been closely approximated. On the other hand, the actual field values of the viscosity ratio and pore volumes of water injected may differ greatly from laboratory conditions, thus possibly rendering actual field values of residual oil different from laboratory obtained values. These limitations should be well in mind before quantitative significance is attached to final oil saturation values which are reported in tabular form below.

<table>
<thead>
<tr>
<th>Core Number</th>
<th>Depth, ft</th>
<th>Porosity, %</th>
<th>Absolute Permeability, md</th>
<th>Initial Water Saturation, % Pore Volume</th>
<th>Permeability to Oil at Initial Water Saturation, md</th>
<th>Final Oil Saturation, % Pore Volume</th>
<th>Permeability to Water at Final Oil Saturation, md</th>
<th>Oil-Water Viscosity Ratio, cp/cp</th>
<th>Total Water Injected, Pore Volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>GF-4</td>
<td>2,575</td>
<td>15.6</td>
<td>1.03</td>
<td>46.9</td>
<td>0.797</td>
<td>29.9</td>
<td>0.0996</td>
<td>18.6</td>
<td>1.94</td>
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<td>GF-8-A</td>
<td>2,583</td>
<td>26.2</td>
<td>112</td>
<td>38.2</td>
<td>21.4</td>
<td>6.49</td>
<td>19.2</td>
<td>23.8</td>
<td>33.7</td>
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<td>21.6</td>
<td>1.13</td>
<td>18.6</td>
<td>25.1</td>
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<tr>
<td>GF-15*</td>
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<td>21.8</td>
<td>24.4</td>
<td>-</td>
<td>14.5</td>
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<td>25.1</td>
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<td>GF-20**</td>
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<td>1.81</td>
<td>67.5</td>
<td>0.961</td>
<td>25.5</td>
<td>-</td>
<td>-</td>
<td>7.25</td>
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*Because of technical difficulties, oil-water relative permeability data were not obtainable on this core; however, the data summarized are presented for comparative purposes.

**Oil-water relative permeability data were not calculable on this core because there was very little oil production after water breakthrough during waterflooding.
### OIL-WATER RELATIVE PERMEABILITY DATA

<table>
<thead>
<tr>
<th>Field</th>
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<tr>
<td>Reservoir</td>
<td>Delaware Sand</td>
<td>Permeability, md</td>
<td>1.03</td>
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<td>Well</td>
<td>TXL &quot;L&quot; 2</td>
<td>Porosity, %</td>
<td>15.6</td>
</tr>
<tr>
<td>Depth, ft</td>
<td>2,575</td>
<td>Oil Viscosity, cp</td>
<td>20.4</td>
</tr>
<tr>
<td>Water Salinity, ppm NaCl</td>
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OIL - WATER RELATIVE PERMEABILITY

FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: TXL "L" 2
DEPTH: 2,575 ft

CORE: CP 4

PERMEABILITY, MD: 1.03
POROSITY, %: 15.6
OIL VISCOSITY, CP: 20.4
WATER VISCOSITY, CP: 1.10

WATER SATURATION: PERCENT

- Oil
- Water

BASIC CORE DATA - RES. ENG. LABORATORY
BY R.D. BEAUERLE APPROVED W.M. STEVENSON, JR.
HUMBLE OIL & REFINING CO.
CORE REPORT 232
OIL-WATER RELATIVE PERMEABILITY RATIO

FIELD    Geraldine Ford
RESERVOIR Delaware Sand
WELL     TXL "L" 2
DEPTH, ft 2,575

CORE      GP-4
PERMEABILITY, md 1.03
POROSITY, % 15.6

100
10
1.0
0.1
0.01

WATER SATURATION, percent

0 30 40 50 60 70 80 90 100

BASIC CORE DATA RES. ENG. LABORATORY
by R.D. Bauerle APPROVED W.M. Stevenson, Jr. 20
HUMBLE OIL & REFINING CO.
CORE REPORT 232
## OIL-WATER RELATIVE PERMEABILITY DATA

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### OIL · WATER RELATIVE PERMEABILITY

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<td>DEPTH</td>
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</table>

![Graph of oil and water relative permeability]

- **Oil**
- **Water**

Water Saturation: Percent

51%

Basic core data—Res. Eng. Laboratory

By J.W. Walker, approved W.M. Stevenson, Jr. 22

Humble Oil & Refining Co.

Core Report 232
OIL-WATER RELATIVE PERMEABILITY RATIO

FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: TXL "L" 2
DEPTH, ft: 2,583

CORE: GF-8-A
PERMEABILITY, md: 112
POROSITY, %: 25.2

BASIC CORE DATA ENG. LABORATORY
by J.W. Walker APPROVED W.M. Stevenson, Jr.

HUMBLE OIL & REFINING CO.
CORE REPORT 232
## OIL-WATER RELATIVE PERMEABILITY DATA

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<th>EFFECTIVE PERMEABILITY TO WATER, md</th>
<th>RELATIVE PERMEABILITY TO OIL, %</th>
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OIL WATER RELATIVE PERMEABILITY

FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: TXL 12
DEPTH: 2,583 ft

CORE: GF-11
PERMEABILITY, MD: 105
POROSITY, %: 25.8
OIL VISCOSEY, CP: 20.4
WATER VISCOSEY, CP: 1.13

RELATIVE PERMEABILITY: PERCENT

WATER SATURATION: PERCENT

- Oil
- Water

59%

BASIC CORE DATA - RES. ENG. LABORATORY
BY W. D. McRae APPROVED W. M. Stevenson, Jr. CORE REPORT 232
OIL-WATER RELATIVE PERMEABILITY RATIO

FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: TXL "L" 2
DEPTH, ft: 2,583

CORE: GP-11
PERMEABILITY, md: 105
POROSITY, %: 25.8

BASIC CORE DATA RES. ENG. LABORATORY
BY: W. D. McRae
APPROVED: W. M. Stevenson, Jr.
HUMBLE OIL & REFINING CO.
CORE REPORT 232
<table>
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OIL WATER RELATIVE PERMEABILITY

FIELD          Geraldine Ford
RESERVOIR      Delaware Sand
WELL           TWL "T" 2
DEPTH          2,593 ft

CORE           GF-12
PERMEABILITY, MD.  44.5
POROSITY, %      23.8
OIL VISCOSITY, CP. 20.3
WATER VISCOSITY, CP. 1.09

---

BASIC CORE DATA—RES. ENG. LABORATORY
BY W. A. Moffett APPROVED W. M. Stevenson, Jr.
HUMBLE OIL & REFINING CO.
CORE REPORT 232
OIL-WATER RELATIVE PERMEABILITY RATIO

FIELD  Geraldine Ford  CORE  GP-12
RESERVOIR Delaware Sand  PERMEABILITY, md  44.5
WELL  TXL "L" 2  POROSITY, %  23.8
DEPTH, ft  2,593

BASIC CORE DATA  RES. ENG. LABORATORY
BY W. A. Hoffett  APPROVED W. M. Stevenson, Jr.
HUMBLE OIL & REFINING CO.
CORE REPORT 232
## Oil-Water Relative Permeability Data

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### OIL WATER RELATIVE PERMEABILITY

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<td>POROSITY, %</td>
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<td>OIL VISCOSITY, CP.</td>
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<td>WATER VISCOSITY, CP.</td>
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</tbody>
</table>

**Graph:**
- **Oil**
- **Water**

**Notes:**
- BASIC CORE DATA - RES. ENG. LABORATORY
- By K. E. Taylor
- Approved W. H. Stevenson, Jr.
- NUMBLE OIL & REFINING CO.
- CORE REPORT 232
**OIL-WATER RELATIVE PERMEABILITY RATIO**

<table>
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---

**Graph: Water Saturation vs. $K_o / K_w'$**

- Water Saturation, percent
- $K_o / K_w'$

---

BASIC CORE DATA RES. ENG. LABORATORY

SY: K. E. Taylor APPROVED W. M. Stevenson, Jr. CORE REPORT 232

HUMBLE OIL & REFINING CO.
## OIL-GAS RELATIVE PERMEABILITY DATA

<table>
<thead>
<tr>
<th>FIELD</th>
<th>Geraldine Ford</th>
<th>CORE</th>
<th>GF-6</th>
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<td>RESERVOIR</td>
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<td>DEPTH, ft</td>
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<tr>
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<th>RELATIVE GAS PERMEABILITY, %</th>
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**NOTE:** Relative $K_g$ was obtained by dividing the effective $K_g$ by the $K_g$ at 100 percent gas saturation.

Relative $K_o$ was obtained by dividing the effective $K_o$ by the absolute permeability measured at 100 percent oil saturation.
OIL—GAS RELATIVE PERMEABILITY

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "1", 2
DEPTH 2,575 ft
METHOD Gas Drive

CORE GF-6
PERMEABILITY, MD. 1.3
POROSITY, % 15.0
OIL VISCOSITY, CP 1.91
GAS VISCOSITY, CP 0.018

RELATIVE PERMEABILITY: PERCENT

LIQUID SATURATION: PERCENT

* Oil
o Gas

BASIC CORE DATA—RES. ENG. LABORATORY
BY G. H. Sawyer APPROVED W. M. Stevenson, Jr. — 34 —
HUMBLE OIL & REFINING CO.
CORE REPORT 232
<table>
<thead>
<tr>
<th>FIELD</th>
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<tr>
<td>WELL</td>
<td>TXL &quot;L&quot; 2</td>
<td>POROSITY, %</td>
<td>15.0</td>
</tr>
<tr>
<td>DEPTH, ft</td>
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**OIL-GAS RELATIVE PERMEABILITY RATIO**

**Liquid Saturation, percent**

BASIC CORE DATA RES. ENG. LABORATORY

by G. H. Savar    APPROVED W.M. Stevenson, Jr. -35-  HUMBLE OIL & REFINING CO.

CORE REPORT 232
## Oil-Gas Relative Permeability Data

<table>
<thead>
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<td>Depth, ft</td>
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<td>Method</td>
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</table>

**Note:** Relative $K_g$ was obtained by dividing the effective $K_g$ by the $K_g$ at 100 percent gas saturation.

Relative $K_o$ was obtained by dividing the effective $K_o$ by the absolute permeability measured at 100 percent oil saturation.
FIELD: Geraldine Ford
RESERVOIR: Delavare Sand
WELL: TXL "L" 2
DEPTH: 2,581 ft.
METHOD: Raftord

CORE: GP-8-B
PERMEABILITY, MD.: 116
POROSITY, %: 26.7
OIL VISCOSITY, CP: 1.91
GAS VISCOSITY, CP: 0.018

BASIC CORE DATA—RES. ENG. LABORATORY
BY S. J. BLACK APPROVED W. M. STEVENSON, JR.
HUMBLE OIL & REFINING CO.
CORE REPORT 232
### OIL-GAS RELATIVE PERMEABILITY RATIO

<table>
<thead>
<tr>
<th>FIELD</th>
<th>Geraldine Ford</th>
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<tr>
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<td>Delaware Sand</td>
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<td>WELL</td>
<td>Tex. &quot;H&quot; 2</td>
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<td>DEPTH, ft</td>
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<tr>
<td>CORE</td>
<td>GP-8-B</td>
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<tr>
<td>PERMEABILITY, md</td>
<td>116</td>
</tr>
<tr>
<td>POROSITY, %</td>
<td>26.7</td>
</tr>
</tbody>
</table>

![Graph of OIL-GAS RELATIVE PERMEABILITY RATIO](image)

BASIC CORE DATA RES. ENG. LABORATORY

BY S. J. Black APPROVED W.M. Stevenson, Jr. -38-

HUMBLE OIL & REFINING CO.

CORE REPORT 232
## OIL-GAS RELATIVE PERMEABILITY DATA

<table>
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<td>Hafford</td>
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</table>

<table>
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<tr>
<th>OIL SATURATION, %</th>
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<th>RELATIVE OIL PERMEABILITY, %</th>
<th>EFFECTIVE GAS PERMEABILITY, md</th>
<th>RELATIVE GAS PERMEABILITY, %</th>
<th>OIL-GAS RELATIVE PERMEABILITY RATIO</th>
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**NOTE:** Relative $K_o$ was obtained by dividing the effective $K_o$ by the $K_o$ at 100 percent gas saturation.
Relative $K_g$ was obtained by dividing the effective $K_g$ by the absolute permeability measured at 100 percent oil saturation.
OIL-GAS RELATIVE PERMEABILITY

<table>
<thead>
<tr>
<th>FIELD</th>
<th>Geraldine Ford</th>
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<tbody>
<tr>
<td>RESERVOIR</td>
<td>Delaware Sand</td>
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<tr>
<td>WELL</td>
<td>T. &quot;T.&quot; 2</td>
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<td>Harkford</td>
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<td>CORE</td>
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<td>POROSITY, %</td>
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<td>OIL VISCOSITY, CP</td>
<td>1.91</td>
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<tr>
<td>GAS VISCOSITY, CP</td>
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</tr>
</tbody>
</table>

BASIC CORE DATA—RES. ENG. LABORATORY
By S. J. Black, Approved W. M. Stevenson, Jr. — 40 — HUMBLE OIL & REFINING CO.
CORE REPORT 232
<table>
<thead>
<tr>
<th>Field</th>
<th>Geraldine Ford</th>
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<tbody>
<tr>
<td>Reservoir</td>
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<td>Porosity, %</td>
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</table>

**Diagram:**

- **Liquid Saturation, percent:**
  - 0.001
  - 0.01
  - 0.1
  - 1
  - 10
  - 100
  - 1000
  - 10,000

- **Graph:**
  - Graph showing relative permeability ratio with liquid saturation percentage on the x-axis and permeability ratio on the y-axis.

**Legend:**

- **K_o**
- **K_g**

**Notes:**

- Basic core data by S.J. Black approved by W.M. Stevenson, Jr.
## OIL-GAS RELATIVE PERMEABILITY DATA

<table>
<thead>
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## O. GAS RELATIVE PERMEABILITY

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<tr>
<td>WELL</td>
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<tr>
<td>METHOD</td>
<td>Rafford</td>
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<td>0.018</td>
</tr>
</tbody>
</table>

### Graph

- **Y-axis**: Relative Permeability: Percent
- **X-axis**: Liquid Saturation: Percent

- **Symbols**:
  - Oil
  - Gas

### Footnotes

- Basic Core Data—Res. Eng. Laboratory
- By F.E. Harrell
- Approved W.M. Stevenson, Jr.
- Humble Oil & Refining Co.
- Core Report 232
FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: TXL "T" 2
DEPTH: ft 2,500

CORE: GF-18
PERMEABILITY, md: 51.4
POROSITY, %: 25.1

LIQUID SATURATION, percent

BASIC CORE DATA RES. ENG. LABORATORY
By F. E. Harrell
APPROVED W. M. Stevenson, Jr.
HUMBLE OIL & REFINING CO.
CORE REPORT 232