Pleasant Bayou, TX
Geopressured-Geothermal Reservoir

J. L. Renner

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Acknowledgements

This presentation is based on the work of Shook (1992), John et al. (1998) and Griggs (2004).

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References


References

John, C. J., Maciasz, Gina, and Harder, B. J., 1998, Gulf Coast Geopressured-Geothermal Program Summary Report Compilation:


Vol. II-A Resource Description, Program History, Wells Tested, University and Company Based Research, Site Restoration: DOE/ID/1336—T1-Vol.-2A, p. i-xxvii and 1-165


Figure 1. - Location of wells investigated for the DOE geopressed - geothermal research program in the Gulf Coast.

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Depth (ft)</th>
<th>Pressure (psi)</th>
<th>Temp. (°F)</th>
<th>Salinity (ppm TDS)</th>
<th>Gas/Brine Ratio (SCF/STB)</th>
<th>Flow Rate (BPD)</th>
<th>Methane (mol%)</th>
<th>CO₂ (mol%)</th>
<th>Other Gases (mol%)</th>
<th>Porosity (%)</th>
<th>Permeability (mD)</th>
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<td>Delcambre 3sd</td>
<td>-12,869</td>
<td>11,012</td>
<td>238</td>
<td>133,300</td>
<td>24.0</td>
<td>10,333</td>
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<td>1.1</td>
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<td>2.6</td>
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<td>7.9</td>
<td>2.5</td>
<td>19.3</td>
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<td>103,925</td>
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<td>88.9</td>
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<td>8.4</td>
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<td>160,000</td>
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<td>2.5</td>
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<td>400.0</td>
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<td>Sweet Lake A</td>
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<td>Gladys McCall A</td>
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<td>Gladys McCall B</td>
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<td>288</td>
<td>94,000</td>
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<td>3.5</td>
<td>22.0</td>
<td>130.0</td>
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<td>Pleasant Bayou</td>
<td>-16,465</td>
<td>9,800</td>
<td>302</td>
<td>127,000</td>
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<td>25,000</td>
<td>65.0</td>
<td>10.0</td>
<td>5.0</td>
<td>19.0</td>
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<td>Hullin No. 1</td>
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<td>360</td>
<td>195,000</td>
<td>34.0</td>
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<td>93</td>
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<td>3.0</td>
<td>3.0</td>
<td>13.0</td>
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<td>Riddle Saldana No. 2</td>
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<td>6,627</td>
<td>300</td>
<td>12,800</td>
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<td>1,950</td>
<td>75.0</td>
<td>21.4</td>
<td>3.75</td>
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<td>15,000</td>
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<td>-</td>
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</table>

From John et al., Vol. I, p.4.
Figure 158. - The Frio, Vicksburg and Wilcox geopressed - geothermal fairways and location of the Pleasant Bayou (#1 & 2) test well in the Frio fairway (from, Gruy Federal Inc., 1980).

Pleasant Bayou 2

• 1978  Drilled to 16,500 ft
  – 12,000 bpd ave. flow rate; total 274,000 bbl
  – 6,000–19,200 bbl/d step test

• 1981  29,000 bbl/d max. flow rate

• 1982-1983 Flow test
  – 3.5 million barrels; 18,200 bpd ave. rate

• 1988-1992  Long-term flow test
  – 18,000 bbl/d ave. rate
  – 3,000 psi ave. wellhead pressure
  – 25 million bbl cumulative flow
Reservoir Model

Shook (1992) combined geology, well tests and reservoir simulation to:

- Determine reservoir limits
- Estimate reservoir volume
<table>
<thead>
<tr>
<th>Rock Properties</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Total pore volume</td>
<td>$4.2 \times 10^{10}$ ft$^3$</td>
</tr>
<tr>
<td>Pore compressibility</td>
<td>distal volume</td>
</tr>
<tr>
<td></td>
<td>proximal volume</td>
</tr>
<tr>
<td>Porosity</td>
<td>distal volume</td>
</tr>
<tr>
<td></td>
<td>proximal volume</td>
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<table>
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<th>Fluid Properties</th>
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<tbody>
<tr>
<td>Bubble point pressure at $T_R$</td>
<td>6500. psia</td>
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<tr>
<td>Viscosity</td>
<td>0.28 cp</td>
</tr>
<tr>
<td>Standard density</td>
<td>69. lb/ft$^3$</td>
</tr>
<tr>
<td>Formation Volume factor</td>
<td>1.049 rb/STB</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Initial Conditions</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Pressure at 14,100 ft SS</td>
<td>10,716. psia</td>
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<tr>
<td>Temperature</td>
<td>306. °F</td>
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<td>Mole fractions:</td>
<td></td>
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<tr>
<td>brine</td>
<td>0.9968</td>
</tr>
<tr>
<td>methane</td>
<td>0.0032 (24 SCF/STB brine)</td>
</tr>
</tbody>
</table>

From Shook, 1992
Geology

- C-zone of the lower Frio sandstone
- Wave-modified deltaic sequence
- Production from distributary channels and channel-mouth bar sandstones
- Bounded by growth faults to west, north and east
- Shook (1992) suggests leaky, pressure-sensitive fault to south
Figure 163. -- Structural map drawn on top of the T1 marker, Brazoria Fairway. The Pleasant Bayou test well site is on the southwest flank of the Chocolate Bayou Domal Structural (from, Bebout, Loucks and Gregory, 1979).

Leaky Fault Evidence

- Transient tests indicate boundary at 6,200 feet
- Tests indicate increase in reservoir size
- Reservoir analysis suggests reservoir recharge is pressure related
- Fault related leakage due to pressure difference
Shook’s Conclusions

• Reservoir is supported through communication along a leaky fault
• Pleasant Bayou 2 is capable of producing 20,000 bbl/day:
  – For 10 years
  – Minimum downhole pressure 8600 psi
Economics

• Early 1990s economic studies suggested marginal economics
• Since then:
  – Higher natural gas prices
  – Higher electrical prices
• New economic study by Griggs (2004)
Griggs’ (2004) Conclusion

“This study shows that the commercial production of geopressured-geothermal aquifers is feasible under reasonable assumptions of natural gas and electricity price. However, the near-term likelihood of large-scale developments of geopressured aquifers is low.”
Why?
(Griggs, 2004)

• Refined resource estimates - brine and methane
• System analysis of gas and energy production
• More efficient binary plants
• More precise economic analysis
• Legal status of development
Exhibit 1.2-2. STRUCTURE MAP ON THE TOP OF THE T5 MARKER