CONF-771153-P1-6

THIRD GEOPRESSURED-GEOTHERMAL ENERGY CONFERENCE

University of Southwestern Louisiana
Lafayette, Louisiana

November 16-18, 1977

VOLUME I

Supported by the
U. S. DEPARTMENT OF ENERGY
under Contract No. EG-77-G-05-5557

Assistance provided by the
American Gas Association

GEOPRESSURE RESOURCE ASSESSMENT - SOUTHERN LOUISIANA

William J. Bernard, Petroleum Engineering
Department, Louisiana State University

ABSTRACT

The geothermal/geopressure potential of the southern Louisiana Tertiary sands, including state-owned offshore waters, has been estimated, with a breakdown of the separate contributions of geohydraulic energy, geothermal energy and natural gas. The total technically recoverable energy in the study area, neglecting surface conversion efficiencies, is estimated at 34.3 quadrillion BTU's, or the equivalent of about six billion barrels of oil. The technically recoverable natural gas content of the geopressured water is about 13.6 trillion cubic feet.

Sixty-three specific prospective areas of geothermal/geopressure energy have been selected for further evaluation and a project is underway to establish the relative importance of these prospects.

INTRODUCTION

In May of 1975, ERDA awarded a contract to Louisiana State University in which the geopressure/geothermal resource of southern Louisiana was to be assessed. The

DISCLAIMER

study area is shown in Figure 1. A report, "Investigations on the Geopressure Energy Resource of Southern Louisiana" (ERDA Contract EY-76-S-05-4889), was issued in April, 1977. This paper presents a synopsis of that report.

DISCUSSION AND RESULTS

Data Acquisition

The study area shown in Figure 1 includes substantially all of the known geopressured area of onshore Louisiana and those offshore areas under state jurisdiction. From some 10,000 wells drilled in this area a total of almost 6,000 were selected as significant to the study. Most of the wells were dry wildcats but the total included one representative well from each of the 700 or so oil and gas fields in the area. The well logs were obtained from the files of the Louisiana Department of Conservation.

The principal data collected consisted of:

- Well location
- Depth and thickness of each sand body
- Bottom-hole temperature and depth for each logging run
- Mud weight for each logging run

Zones shallower than 7000 feet were completely ignored

in the study. Wells showing no geopressure were analysed for bottom-hole temperature and depth, but no mud weight or sand information was recorded. A formation was considered to be geopressured if it were drilled with a mud having a density of 12 pounds per gallon or greater (equivalent to a gradient of 0.624 psi/foot). No attempt was made to correlate the sand bodies from well to well.

The data from the 6000 well logs were stored on magnetic tape, and this collection of data is referred to as the "data base". The data base was used to generate computer drawn contour maps of mud weights and sand fractions for various depth brackets and was also used to make estimates of the quantity and distribution of the geopressure/geothermal energy throughout the area. Table I shows some general statistics for the data base.

Resource Assessment

Data were retrieved from the data base and subdivided into units of geographical location and depth. Geographically, the study area was divided into 40 blocks. These blocks lie between 89 and 94 degrees longitude west and between 29 and 31 degrees latitude north. Each block was 0.5 degrees latitude by 0.5 degrees longitude in size. Each block was then further divided into depth intervals of 10-12,000 feet, 12-14,000 feet, 14-16,000 feet,

16-18,000 feet, and 18-20,000 feet. Therefore the study area was subdivided into 200 units (40 blocks x 5 depth intervals). For each of these 200 units, the following information was retrieved from the data base:

- Average mud weight
- Average sand count
- Average temperature
- Ratio of geopressured wells to total wells

For each one of the 200 units, the following quantities were calculated from the above information:

- Producible Water

  The total resource was assumed to be produced from its existing pressure down to a hydrostatic head of 0.468 psi/foot (9 lbs/gallon). The value of the system compressibility (the major driving force) was assumed to be 20×10^{-6} psi^{-1}.

- Dissolved Methane

  The methane content of the water was calculated using the data of Culberson and McKetta. In this calculation it was assumed that the average methane content was an arithmetic average of the content

at initial pressure and the content at abandonment pressure (hydrostatic head).

- Geothermal Energy

  The thermal energy was calculated as the heat content of the produced water (at bottom hole temperature) down to 120°F. Surface conversion efficiency was neglected.

- Hydraulic Energy

  This is the energy represented by the volume-pressure product of the produced water. The procedure for calculating the volume of produced water was described above. The surface pressure was an average of the initial surface pressure and the final surface pressure (assumed to be zero). Surface conversion efficiency was neglected.

The results of these calculations were summed for all 200 units and are presented in Table II.

The results shown in Table II are believed to be optimistic for the following reasons:

- Surface conversion efficiencies were neglected.

- It is implied that all of the geopressure/ geothermal aquifers found in the study will be of commercial size.
- No economic limits of flow rate were utilized. The well rates were allowed to taper off to essentially zero.
- The aquifer pressures were inferred from mud weight. Many wells, particularly the older ones, were drilled with muds considerably more dense than required to keep the wells under control and the inferred pressure for these wells would be erroneously high.

Still, the resource is worth consideration. Thirty-four quads is equivalent to about 6 billion barrels of oil. The methane content is about 13.6 trillion standard cubic feet. Application of reasonable recovery and conversion efficiencies to these numbers still results in a sizeable resource worth additional evaluation.

Prospect Selection

As part of the original study, sixty-three potential areas of interest were found. These prospects are shown in Figure 1. The prospects were picked concurrently with the building and analysis of the data base and were therefore chosen without full benefit of all of the data.

The primary criteria used in the prospect selection were:

- The area must be removed from existing hydrocarbon production (because of potential legal problems)
- High density drilling mud was used in drilling
- Sufficient geologic well control exists

There was no consideration of sand thickness, temperature, permeability, etc. in the prospect selection. The areal extent of the prospects was determined primarily by the regional faulting.

FUTURE WORK

ERDA has recently awarded LSU a grant whereby the 63 prospects will be ranked, eliminating the obviously inferior ones. The end product of this study will be a recommendation of one or more sites that justify the drilling of a well. Obviously the sites will have to be investigated in much more detail than was done in the initial study. The more promising prospects will be analysed on a reservoir by reservoir basis showing sand thickness, temperatures, salinities, pressures, permeabilities, porosities, etc. The project is currently underway and it is hoped that at least five of the best prospects will have been analysed by August, 1978.

A rough preliminary ranking has been completed and indicates that the better prospects lie in the western half of the study area. This initial ranking utilized parameters such as mud weight, temperature, sand count, and geological control. The prospects in the eastern half of the study area were down-graded primarily because of poorer sand development, but it is entirely possible that several of these prospects will be quite attractive upon closer inspection.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the contributions of Professors Murray Hawkins, Donald Kupfer, and Philip Larimore of LSU; Mr. Leo Hough of the Louisiana Geological Survey; and the geologists of the Louisiana Conservation Commission under the direction of Commissioner Ray Sutton and Assistant Commissioner Arnold Chauviere. Of course, the funding of ERDA made the study possible.

TABLE I

GENERAL STATISTICS ON WELLS IN

DATA BASE

Wells in data base:	5,964
Geopressured wells:	3,626 (61%)
<u>For geopressured wells</u>:	
Shallowest well:	7,504 ft
Deepest well:	25,600 ft
Average depth:	12,980 ft
Maximum temperature:	428°F
Average temperature for 12,087 logging runs:	209°F
Maximum mud weight used:	22.0 ppg (1.144 psi/ft)
Average mud weight for 12,298 logging runs:	14.7 ppg (0.76 psi/ft)
Maximum sand in one well:	2,955 ft
Average sand per well:	434 ft

TABLE II

GEOPRESSURE/GEOTHERMAL RESOURCE

IN STUDY AREA

Geohydraulic	1.2	quads
Geothermal	19.5	quads
Methane	13.6	quads
Total	34.3	quads

FIGURE 1

LOUISIANA

STUDY AREA