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QUARTERLY TECHNICAL PROGRESS REPORT

for

GEOSCIENCE/ENGINEERING CHARACTERIZATION OF THE INTERWELL ENVIRONMENT IN CARBONATE RESERVOIRS BASED ON OUTCROP ANALOGS, PERMIAN BASIN, WEST TEXAS AND NEW MEXICO

Contract No. DE-AC22-93BC14895

Bureau of Economic Geology
The University of Texas at Austin

Contract Start Date: September 29, 1993

Anticipated End Date: September 28, 1996

Government Award $720,000

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Reporting Period: April 1, 1995 – June 1, 1995

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Objectives

The objective of this project is to investigate styles of reservoir heterogeneity that occur in low permeability pelleted wackestone/packstone facies and mixed carbonate/clastic facies found in Permian Basin reservoirs by studying similar facies exposed in the Guadalupe mountains. Specific objectives for the outcrop study include construction of a stratigraphic framework, petrophysical quantification of the framework, and testing the outcrop reservoir model for effects of reservoir heterogeneity on production performance. Specific objectives for the subsurface study parallel objectives for the outcrop study.

Summary of Technical Progress

Outcrop Activities

Core plugs for porosity and permeability measurements were collected from a grainstone and a grain-dominated packstone unit in Plowman Ridge. Samples were taken every 5 feet along horizontal traverses in the middle of the beds. Permeability data are presented in figures 1 and 2 which illustrate the high degree of variability typical of carbonate reservoirs. As can be seen, grainstones are much more permeable than grain-dominated packstones which is also typical of carbonate reservoirs.

Mapping grainstone bodies continues in the Grayburg sequence 2 transgressive systems tract in West Dog Canyon. These grainstones are typically laterally discontinuous. We are gathering geometric data to add to our database of grainstone dimensions, and hope to use this data to construct stochastic simulations of the three-dimensional distribution of grainstone bodies constrained by sequence stratigraphic considerations.

Previously collected permeability data from the Algerita Escarpment have been used to construct a permeability model for the inner ramp facies tract. This model is presented in figure 3 and has been used in water flood simulation experiments to test the importance of various geological and petrophysical parameters on simulation results. Two important considerations are 1) the distribution of thin, discontinuous, high permeability grainstone beds and 2) the vertical permeability. Normally, vertical communication results in improved recovery. However, in this model vertical communication results in cross flow between the discontinuous high permeability beds resulting in early water breakthrough and lower recovery.

Subsurface Activities

We have been working with Unocal technical staff to prepare recommendations for their 1996 budget for the South Cowden Grayburg field. A 640 acre tract of interest was selected by Unocal. A detailed reservoir model has been constructed for this tract and an analysis of well history and production has been completed. Initial discussions with Unocal suggest several possible approaches to recovering additional oil from this 640 acres, including exploiting deeper horizons, reversing injection patterns, drilling short laterals from existing wells, and drilling several infill wells. Unocal currently has plans to drill 4 infill wells in conjunction with Fina Oil Company, who operates the adjacent unit.

Construction of a simulation model for the 640 acre tract is in progress. The first step involving geostatistical analysis of the spatial distribution of petrophysical properties has been initiated.

A report on the geologic characterization of the South Cowden field is being prepared.

Plans for Fourth Quarter

A field trip will be lead by Roger Barnaby into the field area in October in conjunction with the annual project review of the Reservoir Characterization Research Laboratory. Description of the 3-D geometry of grainstone bodies will continue, and a geostatistical analysis on the permeability data will be made. This information will be incorporated into the simulation model.

Working with Unocal on plans to recover additional oil from the South Cowden field will continue, including evaluation of the four wells that are currently planned. Construction of the simulation model will continue with the goal of having initial runs available for the October review meeting in Carlsbad, New Mexico. A draft report on the geology of the South Cowden field will be available by October.

Figure 1. Cycle 9 horizontal traverse in a grain-dominated dolopackstone.

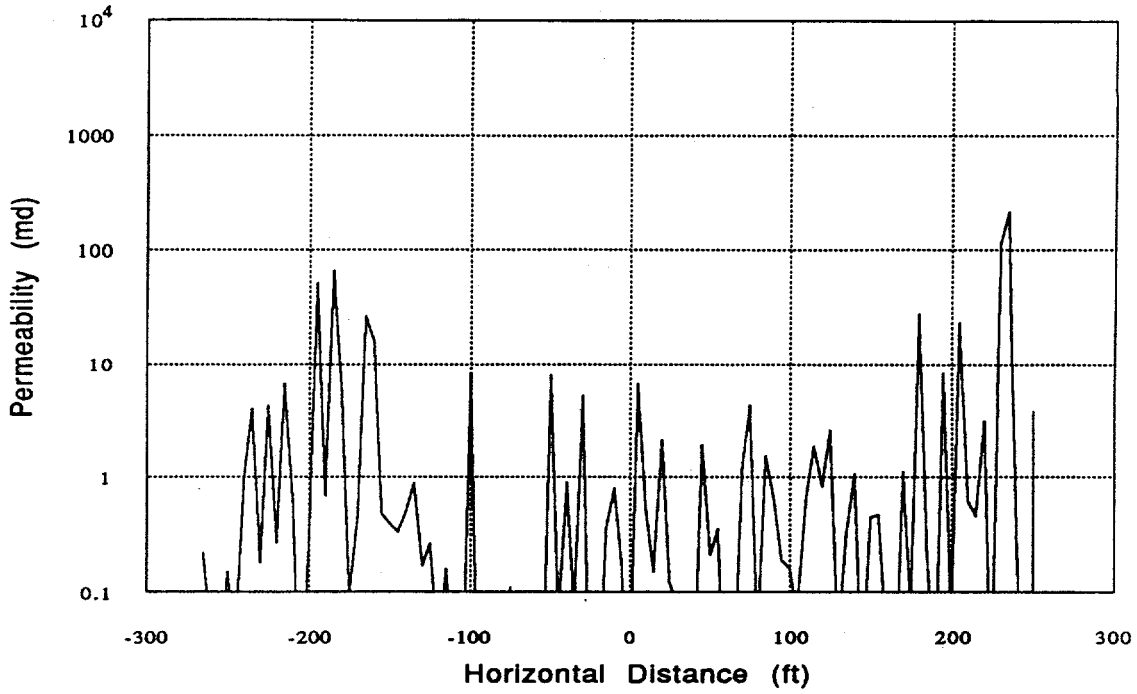
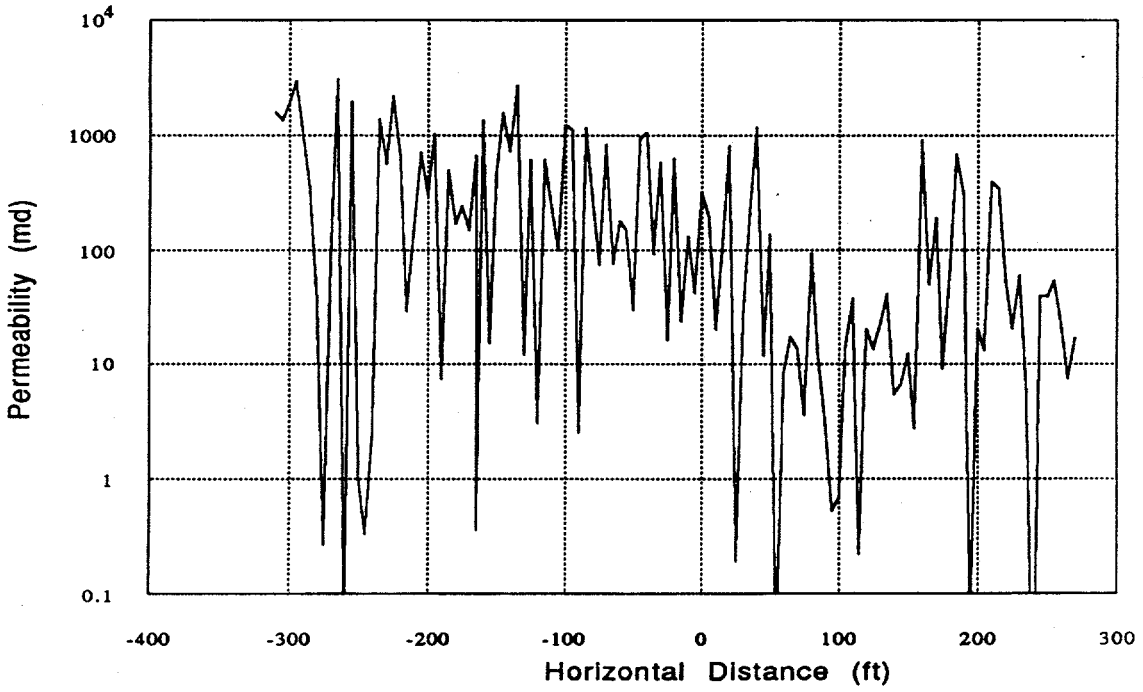


Figure 2. Cycle 11 horizontal traverse in a dolograinstone bar.



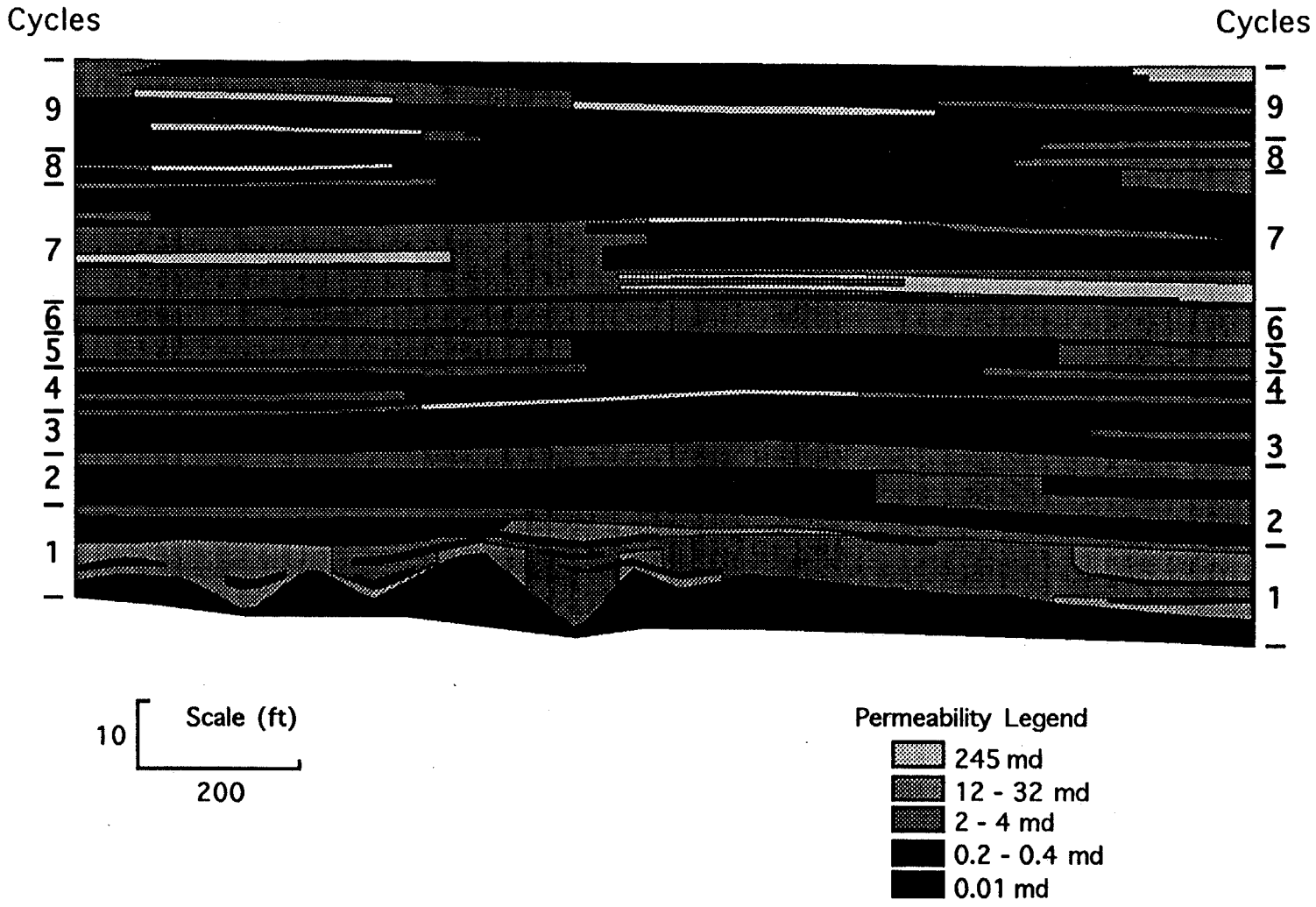


Figure 3. Lawyer - Algerita Canyon inner-ramp permeability model, Algerita Escarpment, Guadalupe Mountains.

U.S. DEPARTMENT OF ENERGY

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MILESTONE SCHEDULE ☐ PLAN ☒ STATUS REPORT

FORM APPROVED
OMB NO. 1900-1400

1. TITLE	2. REPORTING PERIOD	3. IDENTIFICATION NUMBER
Geoscience/Engineering Characterization of the Interwell Environment in Carbonate Reservoirs Based on Outcrop Analogs, Permian Basin, West Texas, and New Mexico	1/1/95 - 3/31/95	DE-AC22-93BC14895

4. PARTICIPANT NAME AND ADDRESS	5. START DATE	6. COMPLETION DATE
Bureau of Economic Geology The University of Texas at Austin P.O. Box X, University Station Austin, Texas 78713	September 29, 1993	September 28, 1996

7. ELEMENT CODE	8. REPORTING ELEMENT	9. DURATION	10. PERCENT COMPLETE	
			a.Plan	b.Actual
1	Geologic Framework		100%	100%
2	Petrophysical Quantification		90%	100%
3	Performance prediction using reservoir simulation		55%	65%
4	Application of outcrop results to subsurface reservoirs		60%	70%
5	Technology transfer		0%	0%

FY94: O N D J F M A M J J A S
FY95: O N D Q2 Q3 Q4
FY96: Q1 Q2 Q3 Q4
FY FY

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

F. J. Lucia
8/17/95