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“T-R Cycle Characterization and Imaging: Advanced Diagnostic Methodology for Petroleum Reservoir and Trap Detection and Delineation”

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Abstract

The principal research effort for Year 1 of the project is T-R cycle characterization and modeling. The research focus for the first nine (9) months of Year 1 is on outcrop study, well log analysis, seismic interpretation and data integration and for the remainder of the year the emphasis is on T-R cycle model development.

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“T-R Cycle Characterization and Imaging: Advanced Diagnostic Methodology for Petroleum Reservoir and Trap Detection and Delineation”

Second Quarter Report for Year 1
December 1, 2003—February 29, 2004

Introduction

The University of Alabama, Wichita State University and McGill University have undertaken a cooperative 3-year research project involving the characterization and modeling of transgressive-regressive (T-R) cycles to facilitate exploration for underdeveloped and undiscovered petroleum resources associated with stratigraphic traps and with specific facies in continental and coastal geologic systems that have reservoir potential.

Executive Summary

The principal research effort for Year 1 of the project is T-R cycle characterization and modeling. The research focus for the first nine (9) months of Year 1 is on outcrop study, well log analysis, seismic interpretation and data integration and for the remainder of the year the emphasis is on T-R cycle model development.

Project Objectives

The objectives of the project are to develop through T-R cycle characterization and modeling a sequence stratigraphic predictive model that can be used for improved petroleum trap and reservoir imaging, detection and delineation by using the characteristics and geometries of T-R cycle units and their associated bounding surfaces to provide a reliable and advanced approach for targeting stratigraphic traps and specific reservoir facies associated with continental and coastal plain geologic systems and to demonstrate the importance of using the concept of T-R cycles in the formulation of advanced exploration strategies in the search for underdeveloped and undiscovered petroleum resources associated with subtle stratigraphic traps and with specific continental and coastal plain reservoir facies.

Experimental

Work Accomplished

Outcrop Study—The assessment of potential outcrops to be studied in the Gulf Coastal Plain has been completed. The assessment of potential outcrops to be studied in Wyoming and Montana is near completion.

Well Log Analysis—With well log data, the following well log patterns have been found to be useful to recognize the T-R cycles. A change from higher to lower gamma ray and/or from more to less positive SP log responses identifies the discontinuity in the log records used to recognize the surface of maximum transgression (Figure 1). This discontinuity separates the transgressive phase from the regressive phase of a T-R cycle. In general, an overall increase in gamma ray or change to more positive SP log response (bell-shaped or fining upward trend)

from the top of a discontinuity (unconformity) in log pattern to the base of the surface of maximum transgression reflects a transgressive backstepping interval, and an overall decrease in gamma ray or change to more negative SP log response (funnel-shaped or coarsening upward trend) from the top of the surface of maximum transgression to the base of a discontinuity (unconformity) in log pattern reflects a regressive infilling interval. The infilling interval frequently consists of a series of these coarsening upward stacking patterns. A cylindrical gamma ray or SP log pattern is used to recognize the transgressive aggradational interval.

Seismic Reflection Interpretation—With seismic reflection data, the following generalizations have been found to be useful to recognize the T-R cycles. Thin (one or two seismic cycles), continuous, parallel seismic reflection configurations are interpreted as strata of the transgressive backstepping phase. These reflections are characterized by onlap reflection terminations (Figure 2). Thick (several seismic cycles), oblique, progradational seismic reflection configurations are interpreted as prograding clinoforms of the regressive infilling phase. These reflectors are characterized by offlap (downlap) reflection terminations.

Work Planned

Outcrop Study—The assessment of potential outcrops to be studied in Wyoming and Montana will continue.

Well Log Analysis—Well log signatures and associated discontinuities inherent to the strata of T-R cycles will continue to be characterized.

Seismic Reflection Interpretation—The process of characterizing seismic reflection configurations and terminations inherent to the strata of T-R cycles will be initiated.

Data Integration—Data integration will continue.

Results and Discussion

The University has initiated the process to hire an individual with seismic experience to work on the project to replace George Puckett.

Conclusions

The project work is on schedule.

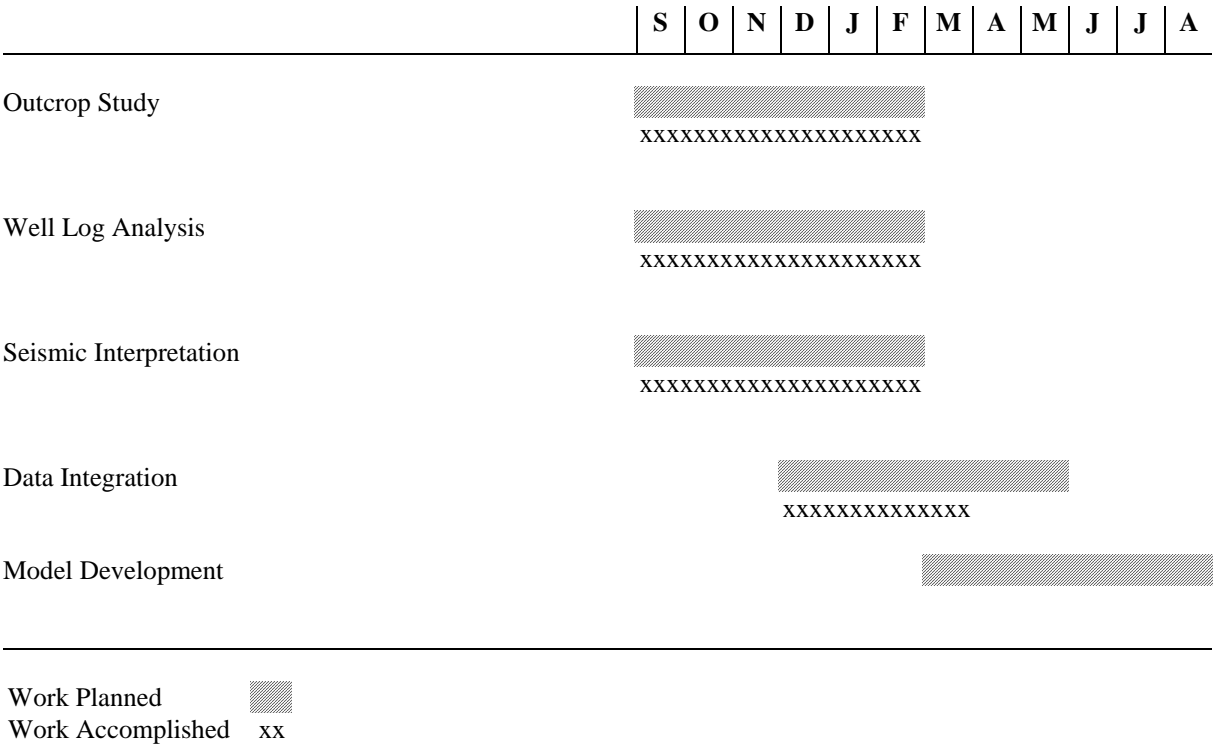
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Table 1
Milestone Chart—Year 1



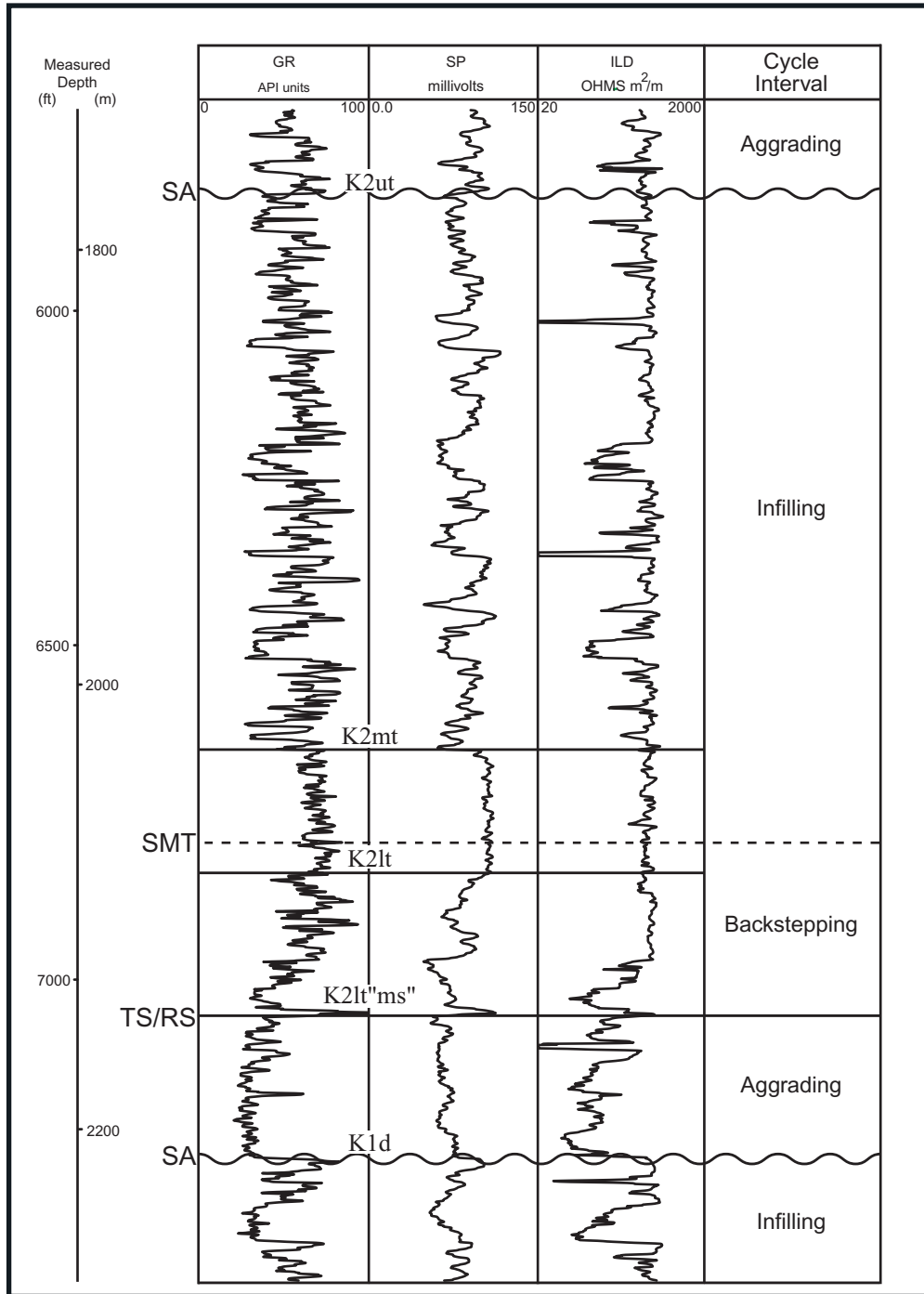


Figure 1. Well log patterns from the Harrison #1 well, North Clark Field, Wayne County, Mississippi, showing the well log signature characteristics for the T R K5 cycle and associated transgressive-regressive intervals. GR=gamma ray, SP=spontaneous potential, ILD=deep induction (resistivity), K1d=Lower Cretaceous Dantzler Formation, K2'tms'=Upper Cretaceous Tuscaloosa Group, "Massive sand," K2lt=Lower Tuscaloosa Formation, K2mt="Marine Tuscaloosa," "Marine shale," K2ut=Upper Tuscaloosa Formation.

Seismic Line, Offshore Alabama

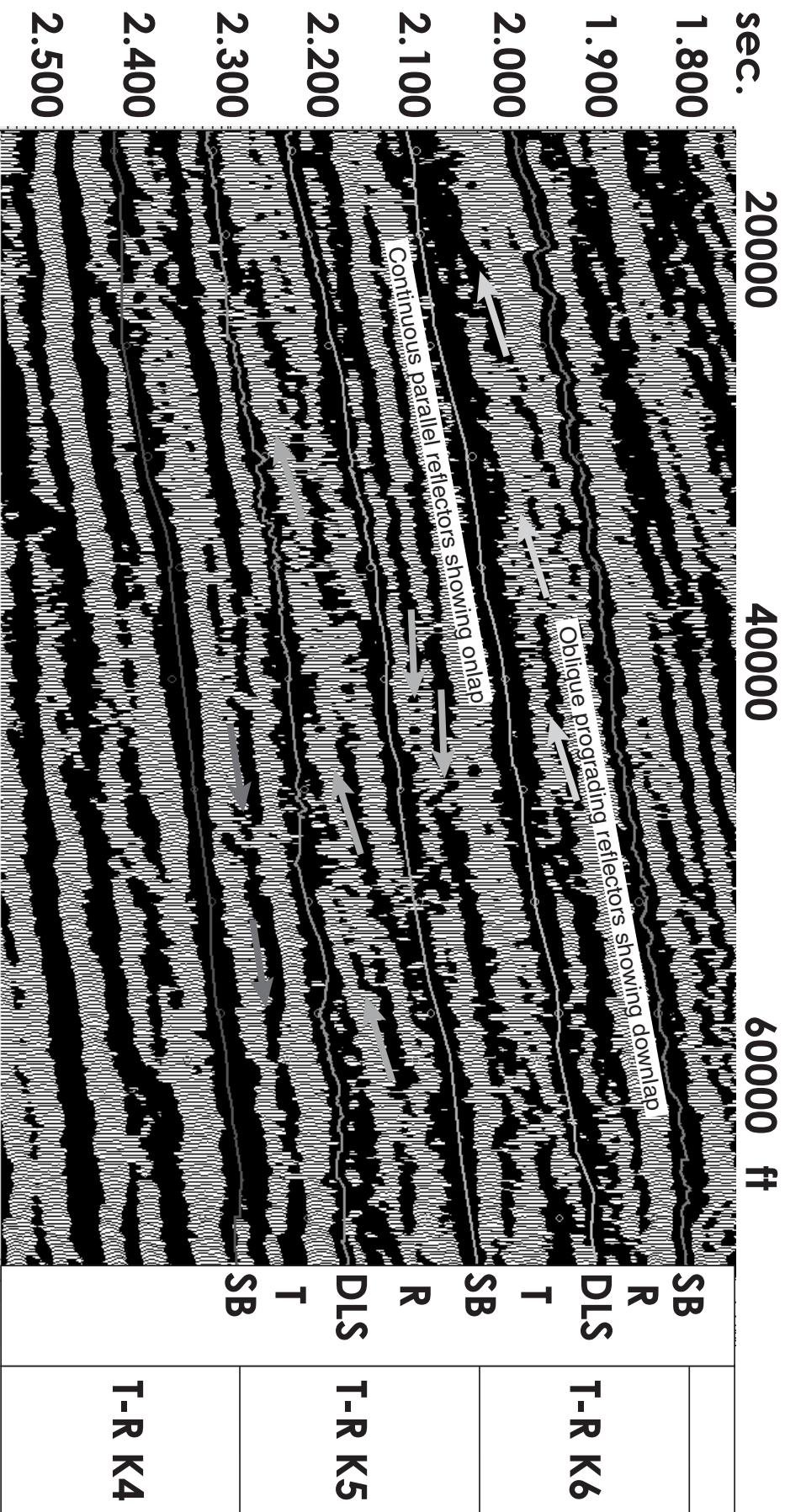


Figure 2. Seismic reflection profile from the offshore area of the northeastern Gulf of Mexico showing the seismic reflection configuration and termination characteristics of strata in the transgressive backstepping interval and the regressive infilling interval of the T R K5 and T R K6 cycles. SB=sequence boundary, DLS=downlap surface, R=regressive phase, T=transgressive phase. Interpretation of seismic line by Kaiyu Liu. Seismic line provided courtesy of Western Geophysical Company.