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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”

Third Quarter Report for Year 1
March 1, 2004—May 31, 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 and in Wyoming and Montana has been completed. Photo documentation of the types of surfaces to be examined and described has been completed. These physical surfaces include subaerial unconformities, transgressive surfaces, ravinement surfaces, surfaces of maximum regression and surfaces of maximum transgression (Figure 1). Knowledge of these surfaces will be used in the construction of the T-R cycle model.

Well Log Analysis—The well log patterns identified to be useful in the recognition of T-R cycles are being used for correlation of subsurface strata present in the onshore area of the Gulf Coastal Plain to strata present in the offshore area of the Gulf of Mexico (Figure 2). This correlation illustrates the diachronous nature of a sequence boundary (Figure 3). The Upper Cretaceous strata above the sequence boundary (UK II) has been dated as older geologically in well #0051 than the strata above this boundary in well #0445. The correlation shows the time-transgressive nature of this surface and the importance of such a correlation for mapping potential reservoir facies.

Seismic Reflection Interpretation—The seismic reflection configurations and terminations identified to be useful in the recognition of T-R cycles (Figure 4) continue to be used to characterize these cycles. In the last report, these seismic reflection configurations and terminations were used to characterize Upper Cretaceous strata. These seismic reflection characteristics have been found to have application to recognize T-R cycles in Upper Jurassic (Figure 5) and Lower Cretaceous (Figure 6) strata.

Work Planned

Outcrop Study—The study of outcrops in the Gulf Coastal Plain and in Wyoming and Montana will continue (Table 1).

T-R Cycle Model Development—The development of a T-R cycle model based on the characterization data and analysis 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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A.

B.

C.

D.

Figure 1. Photographs of outcrops showing physical surfaces: A. Subaerial unconformity at the contact of the Tuscaloosa Group (fluvial deposits) and the Eutaw Formation; B. Ravinement surface at the contact of the unnamed member of the Eutaw Formation (tidal deposits) and the Tombigbee Sand Member of the Eutaw Formation (shoreface deposits); C. Surface of maximum regression at the contact of the Arcola Limestone Member of the Mooreville Chalk (marine shelf deposits) and the Tibbee Creek Member of the Demopolis Chalk (marine shelf deposits); and D. Surface of maximum transgression in the Prairie Bluff Chalk.

Figure 2. Well log patterns showing the well log signature characteristics for physical surfaces as interpreted from well log patterns.

Figure 3. Cross section showing the diachronous nature of a sequence boundary.

Figure 4. Diagram illustrating various possible seismic reflection terminations.

Courtesy of WesternGeco

Figure 5. Seismic reflection profile showing Upper Jurassic T-R cycle designations.

Courtesy of WesternGeco

Figure 6. Seismic reflection profile showing Lower Cretaceous T-R cycle designations.