Stratigraphic Framework and New Exploration Concepts for the Lower Cretaceous Shelf Margin Carbonates of Texas*

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Abstract

Stratigraphic studies, focusing on the Lower Cretaceous Edwards and Sligo margins in East-central Texas, suggest new exploration opportunities. One is based on an extension of the favorable stratigraphy of the Edwards beyond the commonly recognized shelf margin; and another on recognizing that the Sligo margin underwent a major period of exposure resulting in deposition of downslope debris wedges. These examples show how new exploration ideas can be developed in mature areas when new tools and approaches are utilized.

The Edwards - An Underdrilled Opportunity

Analysis of well cuttings and core, coupled with detailed seismic correlation, confirms that the Edwards margin consists of both grainstone and reef facies and shows that both sets of facies repeat themselves several times within the Edwards as the margin prograded. The Edwards margin prograded southeastward >5 km beyond the Sligo margin placing prospective backreef and reef grainstones far seaward of the commonly recognized margin. In essence, there are equivalent facies to those of the Word field complex, a mature Edwards gas field producing at a depth of approximately 3962 m, downdip of the field but the facies lack the underpinning of the Sligo margin for structural drape. The extent of this “opportunity fairway” within Lavaca County alone is over 4.8 km in width and 40 km in length.

3-D seismic and a corresponding geologic cross section show the progradational nature of the Edwards in detail. Three Edwards sequences defined by four key reflectors on the 3-D data occur within one sequence on the 2-D seismic. Reflector 1, which is a high-amplitude event downdip that diminishes in strength updip, occurs at the top of an interval of deeper water argillaceous wackestones (Upper Tamaulipas). Reflector 1 is immediately overlain by a prograding reef/bank complex and distal slope wackestones of the
Edwards margin as seen in cores and cuttings. Reflector 2 is a weak event that ties lagoonal packstone/grainstones to a reef and bank complex and eventually forereef and slope deposits. Reflectors 3 and 4 tie backreef wackestone/packstones to reef and backreef grainstones. It seems clear that the "top Edwards" interval between reflectors 3 and 4 represents a progradational package whose ultimate culmination is even seaward of the study area.

**The Sligo Forereef – An Untested Opportunity**

A 3-D seismic line illustrates a major sequence boundary in the Sligo margin and several events on the seaward side of the margin that display onlap and downlap reflector terminations. These events exhibit the proper architecture to comprise part of a downslope debris wedge in excess of 300 m thick. Although this Sligo forereef and slope play is regional in extent throughout the northern rim of the Gulf of Mexico, the opportunity has yet to be tested.

The existence of a Sligo downslope wedge between the sequence boundary and the overlying Pearsall shale does not guarantee the presence of coarse grained material. It is likely the lowstand created a period of instability, resulting in coarse breccia and grainstone transported further downslope in the form of debris flows and sediment gravity flows. During the subsequent transgression and relative highstand, the Sligo shelf margin initially kept up with sea level rise and continued to contribute grainstone debris downslope. Rapid deposition of the downslope carbonates may have helped to preserve primary porosity by limiting the amount of marine cementation. Data from reservoir analogs confirm that such downslope carbonates can retain reservoir-quality porosity; e.g., Poza Rica field from east-central Mexico. Facies variation and slump faulting on the foreslope creates the potential for trapping and juxtaposition to deep-water carbonates sets up the source and migration pathway. Eventually, the Sligo shelf margin was flooded by a major transgression represented by the Pearsall, which would provide a top seal.

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LOWER CRETACEOUS SHELF MARGIN CARBONATES OF TEXAS

AAPG International Distinguished Lecture Tour

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OUTLINE OF TALK

• Regional and Stratigraphic Setting

• Edwards Play

• Sligo Analog and Play

• Summary
OUTLINE OF TALK

• REGIONAL AND STRATIGRAPHIC SETTING

• EDWARDS PLAY

• SLIGO ANALOG AND PLAY

• SUMMARY
Gulf of Mexico

STUDY AREA

Gulf of Mexico

EDWARDS SHELF TREND
SLIGO SHELF TREND

DETAILED STUDY AREA
GULF COAST STRATIGRAPHY

EDWARDS PROGRADING SHELF MARGIN PLAY

SAKTIONIAN CONIACIAN TURONIAN CENOMANIAN ALBIAN APTIAN BARREMIAN HAUTERIVIAN VALANGINIAN BERRIASIAN TITHONIAN KIMMERIDGAN OXFORDIAN CALLOVIAN
2D SEISMIC FRAMEWORK

DATA BY SEISMIC EXCHANGE INC.
2D SEISMIC FRAMEWORK

DATA PROVIDED BY SEISMIC EXCHANGE INC.
After Baker and Scott (1985)
EDWARDS REEF FACIES

RUDISTS
EDWARDS REEF FACIES

RUDISTS
EDWARDS
GRAINSTONE
FACIES

RUDIST DEBRIS
KEY EDWARDS WELL

FACIES FROM CUTTINGS DESCRIPTION

- BACK REEF GRAINSTONE
- REEF GRAINSTONE
- FORE REEF PACKSTONE
- PROXIMAL SLOPE WACKESTONE
- DISTAL SLOPE WACKESTONE
- DEEP SHELFL ARGILLACEOUS WACKESTONE

PROGRADATIONAL MOTIF

AUSTIN CHALK
EAGLE FORD
BUDA

BACK REEF GRAINSTONE
FORE REEF PACKSTONE
PROXIMAL SLOPE WACKESTONE
DISTAL SLOPE WACKESTONE
DEEP SHELF ARGILLACEOUS WACKESTONE
EDWARDS FACIES ARCHITECTURE

KAHANEK 1
(PROJECTED 13 MILES ALONG DEPOSITIONAL STRIKE)

TOP EDWARDS SB 98

COBY 1

ZARUBA 1

SEISMIC TARGET

Exposure?

Flood back

Lagoonal wackestone

Prograding Edwards margin reef and bank complex

Downlap surface

Prograding Reef

Reef

Distal Slope Wackestone

REFLECTOR 4

REFLECTOR 3

REFLECTOR 2

REFLECTOR 1

REFLECTOR 1

PERFS
14,295 - 14,372
560 MCFD
132 BW

UPPER TAMAULIPAS DEEP WATER
EDWARDS PLAY SUMMARY

Edwards is Largely Stratigraphically Trapped

Porosity Likely Enhanced by Dissolution Along Fractures

Well and Seismic Control Extend Margin Seaward

Refined Stratigraphic and Facies Framework Indicates Exploration Opportunities
2D SEISMIC FRAMEWORK

DATA PROVIDED BY SEISMIC EXCHANGE INC.
DOWNSLIDE BRECCIA IN CORE

Pelagic Mudstone Matrix

Wackestone Clast

Rudist Grainstone Clast

Sutured Contacts
GRAINSTONE DEBRIS IN CORE

Interparticle Porosity of 2%
Moldic Porosity of 13.5%

Rudist Fragments
SLIGO SEQUENCE BOUNDARY
SLIGO PLAY TYPE

SLIGO MARGIN

GOLDEN LANE TYPE MARGIN

POZA RICA TYPE WEDGES

1 MILE
SLIGO PLAY SUMMARY

Poza Rica Analog for Sligo Downslope Debris Play

3d Seismic Essential for Stratigraphic Play Delineation

High-Resolution Sequence Framework Critical for Defining Reservoir and Trap

High Risk but Potentially High Reward
SLIGO OPPORTUNITIES

Gulf of Mexico

OPPORTUNITY FAIRWAY

SLIGO SHELF TREND
SUMMARY POINTS

Although in a Mature Area, the Edwards and Sligo Carbonates Discussed Here are Far From Fully Exploited.

3d Seismic, a Sequence Stratigraphic Framework, and Reservoir Analogs Have Led to New Exploration Play Concepts and Viable Opportunities.