TETRA TECH RPS ENERGY | TRAINING

N343: Depositional Evolution of the GOM Sedimentary Basin

Instructor(s): John Snedden

Format and Duration

Classroom - 3 Days
Virtual - 5 Sessions

Summary

This course explores the stratigraphic and structural history of the Gulf of Mexico, from foundational tectonic influences through the evolution from rift to divergent margin. Examination of the interplay of sandstones and carbonates, the progressive change from Jurassic aeolian systems to Pleistocene abyssal plain fans, and overprint of multiple tectonostratigraphic events allows for key insights regarding reservoir deposition. Areas covered will include the southern Gulf of Mexico as well as onshore.

Business Impact: Students will learn through lectures and exercises how the interaction of **deposition** and **tectonics** (sediment source terrane and basinal salt) set at play level context for **exploration success or failure, development challenges, and production trends** within this unique yet prolific **"super basin";** with an estimated oil and gas endowment over 200 billion barrels oil equivalent.

Learning Outcomes

Participants will learn to:

1. Perform analysis of structurally complex stratigraphic sections from onshore to offshore Gulf of Mexico (GOM), identifying faults and likely detachment surfaces.
2. Discriminate between shelfal, slope, and deepwater reservoirs from seismic character, position on depositional profile, and paleogeographic location.
3. Perform well log correlations at basin scale to identify key depositional fairways for deepwater systems and use log motifs to differentiate distributive fan from poorly organized slope and abyssal plain aprons.
4. Assess continental scale drainage maps to identify sand-prone pathways and key long-lived structural entities in source-to-sink reconstructions.
5. Describe major tectonic and depositional episodes in the GOM, as defined by seismic and well log character.
6. Discern the seismic signature of key depositional intervals as calibrated by key wells from shallow water to deepwater Gulf of Mexico.
7. Identify and evaluate discrete intervals of organic enrichment required for source rocks and shale reservoirs.
8. Define how unconventional reservoir parameters dictate shale success or failure.
9. Evaluate the quality and diversity of established exploration plays ranging from Plio-Pleistocene to Paleogene age in both USA and Mexico.
10. Judge the potential of emerging and frontier exploration plays in Mesozoic strata of deepwater Gulf of Mexico.

Training Method

This is a classroom or virtual classroom course comprising of lectures augmented by six hours of practical

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seismic interpretation well log correlation, and mapping exercises, key to a full understanding of the basin.

Who Should Attend

This practical, example-driven course has been designed for working geoscientists who wish to develop a thorough understanding of the Gulf of Mexico tectonostratigraphic history, supporting regional and prospect evaluation.

Course Content

1. Introduction

- Setting and physiography
- Crustal structure and Mesozoic basin opening
- Structural framework in US and Mexico
- Gravity tectonics, growth structures, salt tectonics, regional shortening, rafting
- Review and understand ten basin-spanning structural cross-sections

Exercise: Seismic interpretation of the US Gulf of Mexico structural margin

- Correlate from onshore to deep offshore basin, crossing multiple depositional margins, growth fault zones, carbonate margins and slope
- Use stratal terminations to identify low-order sequence boundaries and maximum flooding events
- Understand how to use seismic character, within calibrated, well-defined intervals to discriminate sand-prone intervals versus shale-prone sections. Compare to basin-scale paleogeography
- Understand controls on where faults detach; compressional belts

2. Depositional Framework

- Application of lithostratigraphy and chronostratigraphy
- Mesozoic framework
  - Early Mesozoic Rifting and successor-basin phase: Pre-salt models
  - Drift (basin opening) and cooling phase: Louann to end Jurassic
  - Local tectonic and crustal heating phase; role of Chicxulub impact event
  - Conventional (Norphlet, Smackover) and unconventional (Haynesville, Eagle Ford, Tuscaloosa Marine Shale) reservoirs; seals and source rocks
- KPg boundary event and Mexico BTKPs breccia reservoirs
- Cenozoic framework
  - Paleogene Laramide phase (Wilcox, Paleocene Inferior and Superior)
  - Middle Cenozoic Geothermal Phase (Yegua, Frio, Vicksburg, Oligocene)
  - Neogene Tectono-climatic phase (Miocene, Pliocene, Pleistocene)

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Exercise: Use of biostratigraphy and CDS (Chronostratigraphic Designation System) in deepwater Gulf of Mexico

- Use well-based biostratigraphy and CDS to calculate av. sedimentation rates
- Match calculated sedimentation rates and age/depth trends to the most likely structural geometry in particular wells; Mexico versus USA biodatums.

3. Mesozoic Depositional History Jurassic to Cretaceous reservoirs seals source rocks

- Middle Jurassic to Earliest Cretaceous (Bathonian-Berriasian, Louann to Cotton Valley-Bossier)
- Early Cretaceous (Valanginian to Cenomanian, Hosston to Washita)
- Late Cretaceous (Cenomanian to Maastrichtian, Tuscaloosa-Eagle Ford to KPg Boundary mass flows)

Exercise: Recognition of unconventional plays from well logs

- Correlate logs and create cross-sections of Tuscaloosa Marine Shale
- Key Parameters justifying entry into specific shale plays
- ID key TOC-enriched intervals from delta LogR plots
- Understand how local paleogeography enhances shale reservoirs' prospectivity
- Compare to global distribution of discrete organic enrichment events

4. Cenozoic Depositional History

- Paleocene to Middle Eocene (Laramide compression)
- Middle Cenozoic rollover and detachment entrapment of siliciclastics
- Appalachian rejuvenation sub-phase; Midde Miocene Chiapanecan event
- Late Neogene glacial cycles and final salt canopy emplacement

Exercise: Stratigraphy of outboard Wilcox sandstones in northern Gulf based on well logs, 2D seismic, and biostratigraphic data

- Differentiate Wilcox deepwater fans and channel complexes from log motifs
- Recognize how pressure bounding shales relate to maximum flooding surfaces
- Evaluate regional controls on west to east trends net reservoir thickness

5. Established and Emerging GOM Plays

- Established and Emerging Mesozoic Plays (Norphlet Bacab aeolian, Cenomanian-Albian deepwater sandstones, Tampico-Misantla Cretaceous)
- Emerging and Established Cenozoic Plays (Subsalt Paleogene and Miocene, inboard lower Tertiary; Miocene of Mexico-Sureste)

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- Exploration Play Analysis (creaming curves)

Exercise: Map regional sandstone trends of Lower, Middle and Upper Miocene reservoirs in Green Canyon

- Note variations in channel widths and lateral trends reflecting salt tectonics
- Discriminate between axial versus transverse sediment routing pathways and impact on sandstone net to gross, texture, and reservoir performance
- Rank and bid on lease round blocks & consider farm-ins to existing leases