Summary

Business Impact: Students will learn through lectures and exercises how the interaction of deposition and tectonics (sediment source terrane and basinal salt) set a 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.

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 eolian systems to Pleistocene abyssal plain fans, and overprint of multiple tectonostratigraphic events allows for key insights regarding reservoir deposition. Coverage will include the eastern Gulf of Mexico as well as onshore unconventional resource plays.

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 (salt bodies and welds).
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. Assess major tectonic and depositional episodes in the GOM, as defined by seismic and well log anomalies.
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 that are required for source rocks and shale reservoirs.
8. Formulate how structural position and depositional paleogeography controls unconventional reservoir distribution in the greater Gulf of Mexico basin.
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.

Duration and Training Method

A three-day classroom course comprising of classroom lectures augmented by six hours of practical seismic interpretation and well log correlation exercises, key to a full understanding of the basin.

Who Should Attend
This 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.

Prerequisites and Linking Courses

A familiarity with structural and stratigraphic concepts, basic seismic interpretation and basic geological well log evaluation is assumed, such as offered in Basic Application level courses N005 (Tectonic Controls on Basin Development and Petroleum Systems), N085 (Introduction to Seismic Interpretation), and N003 (Geological Interpretation of Well Logs).

This course would be a suitable follow-on from Basic Application level course N043 (Gulf of Mexico Petroleum Systems).

Linked Skilled Application level courses include N071 (Workshop in Geological Seismic Interpretation: Salt Tectonics), N072 (Workshop in Geological Seismic Interpretation: Deep Marine Systems), and N149 (Practical Salt Tectonics).

Course Content

1. Introduction
   - Setting and physiography
   - Crustal structure and basin origin
   - Structural framework
   - Gravity tectonics, growth structures, salt tectonics

   Exercise: Seismic interpretation of the 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 architectural controls on where faults detach and become listric

2. Depositional Framework
   - Application of lithostratigraphy and chronostratigraphy
   - Cenozoic framework
     - Depositional episodes versus sequences
     - Key tectonostratigraphic events
   - Mesozoic framework
     - Rift to divergent margin transition
     - Key tectonostratigraphic events
     - Interplay of carbonates, evaporites, and siliciclastics
- Unconventional reservoirs: Haynesville, Eagle Ford, and Tuscaloosa Marine Shale

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

- Use well-based biostratigraphy and CDS to calculate average sedimentation rates
- Match calculated sedimentation rates and age/depth trends to the most likely structural geometry in particular wells

3. Mesozoic Depositional History

- 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 thermal phase
- Appalachian rejuvenation sub-phase
- Late Neogene glacial cycles and final salt canopy emplacement

Exercise: Onshore to offshore Mesozoic and Cenozoic stratigraphy in Gulf of Mexico based on 2D seismic, well logs, and biostratigraphic data

- Correlate via wells and seismic data from onshore Mesozoic to deepwater subsalt
- Recognize how salt carapaces provide key insights into Mesozoic source rocks of deep basin
- Discriminate between suprasalt plays, deep shelf sub-weld plays, and subsalt plays of the ultra-deepwater

5. Established and Emerging GOM Plays

- Established and Emerging Mesozoic Plays (Norphlet eolian, Jurassic forereef, Valanginian and Cenomanian deepwater sandstones)
- Emerging and Established Cenozoic Plays (Subsalt Paleogene and Miocene, inboard lower Tertiary)
- Exploration Play Analysis