

## N670: Fluvial and Coastal Clastic Depositional Environments (*Texas Gulf Coast, USA*)

Instructor(s): Anton Wroblewski

### Format and Duration

Field - 5 Days  
Moderate Physical Demand

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## Summary

This course provides hands-on experience with a variety of modern, clastic reservoir geobody types that provide calibration points for accurate facies and reservoir models and allow for more targeted exploration, appraisal, and development wells, ultimately increasing reservoir production potential and overall profitability. Participants will examine underfilled and overfilled incised valley systems, meandering fluvial point bars, microtidal bayhead deltas, barrier islands, spits, tidal inlets, flood tidal deltas, a wave-dominated delta, tidal flats, creeks, and oyster reefs, and proximal-distal vs. strike-fed coastal reservoir bodies. Many of these deposits and locations are the basis for the most commonly used depositional models of coastal and fluvial geobodies. Participants will learn when these are and are not the best analogs to use and how unique features of each system affect its resulting stratigraphy and sedimentology. Geomorphology, stratigraphy, and sedimentology are linked through the use of trenches, outcrop and core images, and log data to provide insights into three-dimensional subsurface interpretations.

## Learning Outcomes

Participants will learn to:

1. Identify fluvial, deltaic, tidal inlet, bay margin, and barrier island/shoreface deposits based on grain size profile, sedimentary structures, and ichnofossils.
2. Predict reservoir properties of a variety of fluvial and coastal geobodies away from well bore and beyond seismic resolution by using first principle observations and appropriate analogs.
3. Recognize and predict the presence of strike-fed and point source sandstone bodies in coastal settings using regional context and physicochemical proxies.
4. Construct depositional environment maps constrained and informed by appropriate modern and ancient analogs.
5. Recognize that fluvial systems and their associated coastal deposits and incised valleys are primarily driven by sediment supply and climate in the drainage basin and can be decoupled from sea level changes.

## Training Method

This is a field course, supported by classroom sessions in a 70:30 ratio. Classroom sessions will comprise presentations, case studies, exercises, and reviews of the fieldwork.

## Physical Demand

The physical demands for this class are MODERATE according to the Nautilus Training Alliance field course grading system. The class is conducted in sandy and muddy fluvial, deltaic, and strandplain settings of Texas. Weather can be cool and damp or hot and humid, depending on the time of year. The longest walk in the class is less than 4 km (2.5 miles) with no elevation gain. Most days are spent in open areas, with little shade from the sun. Stray cats, alligators, and insects are prevalent. Participants will dig trenches in some areas and should expect to get wet on most days. Buoyancy aids are provided.

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## Who Should Attend

Exploration and production staff working fluvial and shallow marine environments, including integrated asset teams of geologists, geophysicists, and reservoir, petroleum, geothermal, and CCS engineers.

## Course Content

### Day 0:

- Participants travel to Houston, TX (George Bush International airport).
- Evening lecture on course content and introduction to local and regional geological context, implications for potential analogs, natural history, and wildlife.

### Day 1: Fluvial, Bayhead Delta, and Spit Deposits in an Underfilled Incised Valley

- Trinity River point bar deposits and fluvial processes in the 9 km wide incised valley. We will compare the modern river to the older, mid-Holocene river and a variety of outcrop and subsurface analogs.
- Salt Wedge Barrier: Visit a salt intrusion barrier and review the role of climate and runoff in migration of salt wedges upstream in estuaries and coastal rivers.
- Trinity Bayhead Delta: Examine the fluvial-marine transition in an underfilled valley, with an emphasis on grain size, heterogeneity, and biogenic structures.
- Bolivar Peninsula and Galveston Tidal Inlet: Explore the role of wave energy on open and protected coastlines of a spit and take a ferry ride across the 2.6 km wide tidal inlet.

### Day 2: Microtidal, Wave-Dominated Barrier Island

- Shoreface, Foreshore, and Backshore deposits: Facies and diagenetic features will be examined in trenches with an emphasis on reservoir quality implications and preservation potential. Salinity comparisons of surface and groundwater across a seaward-landward transect to evaluate surface and groundwater flow patterns. Discuss lateral vs. proximal-distal sediment delivery on open coastlines.
- Back-Barrier Deposits: Sample sediment and biogenic features in washover and bay deposits for comparison to bayhead delta, spit, and shoreface deposits.
- Spit/Tidal Inlet Deposits: Hike 1.5 km to investigate the facies, grain size, and heterogeneity of a laterally migrating spit/tidal inlet. Trenches dug into individual accretion ridges facilitate discussions about potential reservoir plumbing and behavior. Outcrop examples of tidal inlets will be compared to the modern system.

### Day 3: Microtidal Tidal Inlet, Distributary Mouth, and Fluvial Bars in an Overfilled Incised Valley

- Flood and Ebb Tidal Deltas: Observe the difference in morphology and sedimentary processes between these types of deltas and explore the role of inherited topography on the location and size

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of the tidal inlet.

- Tidal Creek and Back-Barrier Ponds: Sample sediment and ichnites at Drum Bay kayak launch to explore the role of these environments in potential hydrocarbon generation and reservoir volume. Facies comparison to Galveston and Bolivar and discussion about the origin and evolution of each barrier facilitate discussion of the mechanisms for barrier island construction and preservation.
- Abandoned Distributary Channel Mouth: At Surfside Jetty County Park, observe and discuss the role of avulsion and sediment supply in delta progradation, abandonment, and transgression.
- Point Bar and Channel Cutoff: At Cone Island, sample sediment and investigate the geometry and reservoir implications of an abandoned Brazos River channel belt with an isolated point bar and flooded channel cutoff.

### Day 4: Wave-Dominated Delta in an Overfilled Incised Valley:

- Beach Accretion Ridges: Cruise seaward down the San Bernard River to investigate the wave-reworked mouth bars of the Brazos River, which are now a beach ridge dominated strandplain. Surface observation and trenching facilitates discussion of reservoir properties and the role of local physiographic features on continuity and heterogeneity of depositional elements.
- Wave-Reworked River Mouth: Explore a storm wave modified river mouth to determine the role of autogenic vs. allogenic processes.
- Abandoned Wave-Skewed River Channel: Sample sediment and ichnites in an abandoned channel that was cutoff by lateral migration of strandplain deposits.

### Day 5: Bayhead to Open Coast, River-Dominated Delta in an Overfilled Incised Valley

- Distributary Channel: Cruise down the main, artificial distributary channel of the Colorado River to examine smaller, natural channels and compare them to fluvial channels.
- Mouth Bars: Compare stable, vegetated mouth bars to younger, evolving mouth bars using trenches, surface observation, and satellite imagery.
- Abandoned River Mouth: Discuss the evolution of the Colorado River from a log jammed sediment trap to an active, delta-building system and the rate of progradation in a moderate sized tributary river delta.
- Houston: Course Review and final banquet.

### Day 6: Participants depart Houston, TX.