
N096: Recent Depositional and Stratigraphic Analogues for Fluvial and Shallow Marine Reservoirs (*South Carolina, USA*)

Instructor(s): Jerry Sexton

Format and Duration

Field - 5 Days
Moderate Physical Demand

Summary

Business Impact: To experience first hand the scale and complexity of facies relationships is **invaluable**. By attending the course, participants will gain a greater understanding of marginal marine shorelines and the associated facies, which would facilitate **development of more accurate reservoir models** or allow for more targeted exploration wells, ultimately increasing reservoir production potential and overall profitability.

Participants will examine and sample modern alluvial, deltaic, estuarine, barrier island, tidal channel, and shallow-shelf facies to understand the growth, geometry and heterogeneity of reservoir sandbodies. Geomorphology and stratigraphy are linked through the use of trenches, cores and log data to provide insights into three-dimensional subsurface interpretations.

Learning Outcomes

Participants will learn to:

1. Illustrate the 3D geometry and heterogeneity of sandbodies deposited in alluvial, deltaic, estuarine, barrier island, shallow shelf, and tidal channel settings.
2. Calculate facies trends in the subsurface that will allow the potential to predict reservoir trends.
3. Identify mesotidal and microtidal deposits and interpret their morphology and stratigraphy on log and core data.
4. Demonstrate mesotidal and microtidal shoreline trap types.
5. Use trenching and coring techniques to examine modern depositional environments.
6. Distinguish physical processes responsible for the deposition of reservoir quality sediments.
7. Demonstrate the impact of the hydrodynamic regime (i.e. waves, tidal range) on geomorphology, lithofacies, and stratigraphic interpretations.

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 South Carolina. Weather can be cool and damp or hot and humid, depending on the time of year. The longest walk on the class is less than 5 km (2.5 miles) with little to no elevation gain. Most days are spent on a large pontoon boat, with little shade from the sun. There will be several foot excursions onto beaches as well as into swampy and muddy areas where insects are prevalent. Participants may be asked

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to dig trenches in some areas and should expect to get wet on most days. Buoyancy aids are provided.

Who Should Attend

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

Prerequisites and Linking Courses

There are no prerequisites for this course, but geoscience participants would benefit from some knowledge of sequence stratigraphy and fluvial through shallow marine facies, such as presented in N251 (Well Log Sequence Stratigraphy: Applications to Exploration and Production) and N410 (Sequence Stratigraphy Applied to Exploration and Production).

Nautilus Training Alliance field courses that visit ancient equivalents of the sediments examined on this course include N451 (Practical Oil-Finders Guide to Siliciclastic Sequence Stratigraphy (Wyoming)), N011 (High Resolution Sequence Stratigraphy: Reservoir Applications (Utah)), N042 (Reservoir Sedimentology and Stratigraphy of Coastal and Shelfal Successions: Deltas, Shorelines and Origins of Isolated Sandstones (Colorado)), and N012 (Reservoir Modeling Field Class (Utah)).

Course Content

This intensive field course introduces and links a range of fluvial, deltaic, strandplain, estuarine, barrier island, and tidal channel facies and environments into regional depositional systems. Genetically related depositional environments and their stratigraphic correlation are stressed from the standpoint of subsurface interpretation for prospect evaluation and reservoir development.

Participants will experience the fluvial, deltaic, barrier-island, and estuarine settings along the mesotidal South Carolina coast. This course reveals how geomorphology and lithofacies in shallow-marine deposits are controlled by the hydrodynamic regime (i.e. waves, tidal range). The contrast is striking and profoundly affects stratigraphic interpretations. Additionally, the evolution of Quaternary strata is presented in a chronostratigraphic context. Subsurface data provide lithologic interpretations for progradational (barrier island, deltaic), retrogradational (barrier island, estuarine), and aggradational (valley fill, barrier island) depositional styles. Lateral facies-association and lithofacies changes are discussed from the basin scale (exploration fairways) to the reservoir scale (permeability controls).

Day 0

- Participants travel to Columbia, SC.
- Evening lecture on course content and introduction to local geological setting, natural history and wildlife.

Day 1: Alluvial-valley and Fluvial Deposits

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- Congaree River channel and point bar: Examine channel and point-bar morphology. Discuss fluvial depositional processes (alluvial-valley formation, sediment composition, transport/deposition, channel migration and formation of channel belts, avulsion).
- Congaree Swamp National Park: Walk through part of the Congaree River floodplain to see floodplain geomorphology, abandoned channel courses (oxbow lakes), fine-grained overbank deposits in alluvial-valley fill.
- Congaree River Valley: View the active channel and channel belt, abandoned-channel belts and oxbows, and floodplain filling the 6 km wide valley.

Day 2: Geology and Evolution of a Mixed-Energy Delta

- Santee River Alluvial Valley/Upper Delta Plain: Observe point-bar and abandoned-channel deposits. Compare to Congaree River sediments from 160 km upstream.
- Upper delta plain/natural levee: Sample sediments, observe delta-plain morphology on a traverse across a natural levee into the interdistributary delta plain, and review stratigraphy of upper delta plain.
- Lower delta plain: Observe features of channel bars, upper-delta plain swamp to lower-delta plain marsh transition. Sample distributary sediments and discuss stratigraphy of lower delta plain.
- Distributary mouth: Note dynamics of fluvial and tidal depositional processes (sedimentary structures and lithofacies). Sample delta-plain, distributary-channel and tidal-flat sediments.
- Delta Front: Walk and trench the delta front. Note and discuss depositional processes, geomorphology of a mixed-energy delta, delta stratigraphy, and preservation potential.
- Distributary-mouth bar: Cruise seaward to experience the distributary-mouth bar scale. Sample bottom sediments.

Day 3: Mesotidal Barrier Island

- Capers Island: Observe back-barrier geomorphology, tidal-channel bathymetry, and deposits (tidal creek, salt marsh).
- Price Inlet channel: Discuss tidal inlet dynamics and sedimentation patterns. Sample channel sediments from inlet throat out to the ebb-tidal delta terminal lobe.
- Ebb-Tidal Delta: Walk on the swash platform to observe the geomorphology, sediments and sedimentary structures, and stratification in trenches.
- Capers Island: Walk through a marginal-flood channel of Price Inlet. Contrast deposits with those from the main ebb channel.
- Abandoned Price Inlet Channel: Discuss inlet migration history and resultant stratigraphy. Note impact of inlet migration on the barrier lithosome.
- Beach Walk: Note and discuss foreshore/shoreface depositional processes, sedimentary structures, progradational evolution, stratigraphy, and preservational style.

Day 4: Core Laboratory

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- Geographic and geomorphologic overview of Pleistocene and Holocene setting. Discuss wave-dominated microtidal back-barrier and barrier-island depositional systems.
- Groups describe a selection of previously collected modern cores. Geologic and stratigraphic discussions are lead by the participants. Stratigraphic preservation, correlation, and reservoir quality are emphasized.
- Review and discuss the subsurface exercises for fluvial and shallow-marine depositional systems.

Day 5: Mesotidal Estuary and Incised Valley Fill Sequence

- Snuggedy Swamp: Take a short walk through freshwater marsh into forested swamp. Sample peat and estuarine sediments overlying a Pleistocene unconformity.
- Hole-in-the-Wall: Oxbow cutoff on the Ashepoo River. Sample bottom sediments in river and oxbow. Discuss differences in coastal-plain versus piedmont derived sediments.
- Brackish Marsh: Note geomorphic and sedimentologic changes as tidal influence increases
- Two Sisters Mud Flat: Traverse tidal flat to observe structures, biota, and sediments on a diagnostic estuarine feature. Discuss tidal-flat deposition and controls on sediment composition, and auto-versus allocyclic systems.
- Review geomorphology, sedimentation patterns, and scale of the marine-dominated lower estuary using maps.
- Charleston: Course review and final banquet.

Day 6

- Participants depart Charleston, SC.