Shoreline and Shelf Reservoir Systems, Colorado (G013)

Tutor(s)

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Overview

This course contrasts two very different clastic shoreline systems by studying two sets of outcrops that were deposited at approximately the same time, about 100km (62 miles) away from each other. One set was deposited by classic river-feed, wave dominated delta systems and the other set had depositional strike-feed systems. The wave dominated deltas are common reservoirs in many basins. However, the less common strike-feed systems have a very different stratal architecture, which can result in the development of significant stratigraphic traps. Participants will develop competence in understanding clastic shoreline and shelf systems and applying sedimentology and sequence stratigraphic concepts to build depositional models and predict facies distributions.

Duration and Logistics

A 8-day field trip comprising a mix of classroom lectures (10%) and field time (lectures and exercises 90%). The course begins in Craig, Colorado, and ends in Steamboat, Colorado. Participants fly in and out of Hayden, Colorado.

Level and Audience

Advanced. Geologists, geophysicists and reservoir engineers working on fluvial / deltaic exploration and production projects. This course is especially relevant for people working reservoirs that were deposited under a tidal influence. The material is presented with minimal jargon so that reservoir engineers can get the maximum benefit of the material.

Exertion Level

This class requires a **MODERATE** exertion level. Scrambling over rock outcrops and steep sections will be required, but most hikes would be considered moderate. The longest hike is approximately 3.2km (2 miles). Outcrops are at elevations of 1300–2000m (3900–6000 ft). Weather conditions in NW Colorado can vary from warm and dry to cold and wet, with an early fall temperature range of 6–25°C (42–78°F). Transport will be in SUVs on paved and unpaved roads.

Objectives

You will learn to:

1. Evaluate facies associated with wave dominated deltas, tidal shelf deposits and the often-under-recognized strike-fed tidally influenced shoreline deposits.
2. Compare depositional dip and strike facies variations within a wave dominated delta complex at the regional scale.
3. Distinguish deltaic distributaries from incised valley deposits associated with an unconformity.
4. Identify facies and subsurface geometries of isolated, tidally dominated shelf reservoirs and understand possible links to older shoreline deposits and processes that controlled genesis of these

stratigraphic traps.

5. Use sequence stratigraphic principles to distinguish sequence boundaries, flooding surfaces, transgressive surfaces of erosion and maximum flooding surfaces.
6. Begin to use the concepts of shoreline stacking patterns to better predict lateral continuity of shoreline systems.
7. Make interpretations of reservoir systems from subsurface data based on the techniques practiced in the field.

Course Content

Course Details

This course emphasizes:

- Facies associated with:
  - wave dominated deltas
  - siliciclastic shelf deposits (isolated shelf-bar sandstones)
  - tidally influenced shoreline deposits
- Depositional dip and strike facies variations within a wave dominated delta complex
- Recognition and significance of key stratigraphic surfaces:
  - sequence boundaries
  - flooding surfaces
  - transgressive surfaces of erosion
- Identification of deltaic axes through the recognition of distributaries
- Recognition of tidally influenced inter-deltaic reservoir systems
- Factors controlling genesis of isolated siliciclastic shelf reservoirs
- Techniques for recognition of reservoir systems in subsurface data

The course focuses on understanding and reducing stratigraphic risk through interpretation of existing data sets. Superb outcrops provide the foundation for a series of field stops that demonstrate pitfalls of lithostratigraphic correlations and the utility of using chronostratigraphy to better understand the architecture of reservoir systems. Initial lectures and outcrop exercises focus on understanding how sediment supply and accommodation space control stratal architectures in wave dominated systems at various scales. Emphasis is placed on how to use small-scale observations of stacking patterns, often seen in well logs, to predict the larger scale facies architecture. Then outcrops of isolated sand bodies within the Mancos Shale are investigated, which provide insights into subsurface equivalents that can be involved in stratigraphic traps. Finally, outcrops of inter-deltaic shoreline deposits provide examples of important reservoir systems that are not commonly studied.

Outcrops are used to demonstrate (a) recognition of facies using sedimentology, (b) reservoir geometries, (c) subdivision of reservoirs into flow units, (d) variations in Kv and Kv/Kh of flow units, (e) key stratigraphic surfaces, (f) impact of stratigraphic and structural heterogeneities on reservoir fluid flow at a production well spacing interval and (g) what needs to be captured in geologic models.

Day 1: Arrive in Hayden

Participants arrive in Hayden and travel to Craig, Colorado.

Overnight in Craig.

Day 2: Wave dominated deltas

Classroom:

- Course introduction and safety brief

Fieldwork:

- Wave dominated delta deposits of the Iles 1 and 2, west of Craig

Overnight in Craig.

Day 3: Wave dominated deltas

Classroom:

- Sequence stratigraphy

Fieldwork

- Iles 1, 2 and 3, south of Craig

Overnight in Craig.

Day 4: Tidally influenced shelf deposits

Fieldwork:

- Fieldwork south of Craig reviewing regional stratigraphic variations in wave dominated deltas
- Study of tidally influenced shelf reservoirs

Overnight in Craig.

Day 5: Downdip settings

Fieldwork:

- Castlegate downdip pinch out

Overnight in Rangely, Colorado.

Day 6: Shorelines

Fieldwork:

- Strike-fed shorelines of the Lower Sego Sandstone

Overnight in Rangely.

Day 7: Sego Sandstone

Fieldwork:

- Lower Sego Sandstone

Classroom:

- Course summary and wrap up

Overnight in Steamboat Springs.

Day 8: Departure

Departure and travel home.