Clastic Reservoirs: Stratigraphic and Structural Heterogeneities that Impact Reservoir Performance, Colorado and Utah (G012)

Tutor(s)

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Overview

The course investigates world-class outcrops to introduce all subsurface disciplines to a wide spectrum of stratigraphic and structural features commonly found in exploration and production. An active learning technique encourages participants to make initial observations and interpretations before group discussions. Lectures and exercises provide an awareness of reservoir architecture in a variety of stratigraphic and structural settings while outcrops demonstrate field- and reservoir-scale structural heterogeneities. Depositional environments studied include deltaic, eolian, fluvial, turbidites, tidal, lacustrine and coastal plain. Emphasis is placed on understanding flow characteristics (i.e. connectivity, Kv, Kv/Kh). A practical approach to using sequence stratigraphic concepts is also presented.

Duration and Logistics

A 6-day field course comprising a mix of classroom lectures (10%) and field exercises (90%). The course begins and ends in Grand Junction, Colorado, and visits outcrops in Utah and Colorado.

Level and Audience

Fundamental. This course is presented with minimal jargon so that non-geoscientists, such as reservoir engineers and petrophysicists, get the full benefit of the course. However, it would be particularly suitable for geoscientists working on fluvial/deltaic exploration and production projects, to show how common stratigraphic and structural variations can impact reservoir performance.

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 walk is approximately 4.8km (3.2 miles). Outcrops are at elevations of 1200–2500m (4000–8200 ft). Weather conditions in NW Colorado and eastern Utah can vary from warm and dry to cold and wet, with an early fall temperature range of 5–23°C (41–73°F). Transport will be in SUVs on black-top and unpaved roads.

Objectives

You will learn to:

1. Divide subsurface reservoirs into flow units that capture key reservoir flow characteristics and heterogeneities at a variety of reservoir model scales.
2. Communicate and discuss flow unit properties between subsurface team disciplines.
3. Understand detailed facies analysis within deposits of wave dominated deltas, fluvial dominated deltas, fluvial systems, tidal / estuarine, eolian and turbidites.
4. Recognition of key facies in cores and logs.

5. Use key sequence stratigraphic concepts in a practical and predictive way.

Course Content

Course Details

This course emphasizes:

- An overview of facies associated with:
    - fluvial and wave dominated deltas
    - fluvial systems
    - eolian deposits
    - tidally influenced shoreline deposits
    - turbidites
    - lacustrine
    - incised valley fill
- Sequence stratigraphic concepts including:
    - sequences and parasequences
    - sequence boundaries
    - flooding surfaces and transgressive surfaces of erosion
- Structural heterogeneities, such as:
    - fractures, deformation bands and fault seal

Course lectures and exercises provide participants with an awareness of reservoir architecture in a variety of stratigraphic and structural settings. Depositional environments studied in outcrops include deltaic, eolian, fluvial, turbidites, tidal, lacustrine and coastal plain. Emphasis is placed on understanding reservoir geometry and fluid flow characteristics (i.e. connectivity, Kv, Kv/Kh) in the various reservoir facies studied. Outcrops are also used to demonstrate field and reservoir scale structural heterogeneities.

Outcrop exercises 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.

A practical approach to using sequence stratigraphic concepts is also presented.

Day 1: Arrive in Grand Junction

Classroom:

- Course introduction and safety briefing

Overnight in Grand Junction, Colorado.

Day 2: Alluvial deposits

Classroom:

- Introduction to alluvial depositional systems

Fieldwork:

- Locations west of Grand Junction looking at outcrops of lacustrine, fluvial and eolian formations
- Discussions about basin history, geochemistry and fractures

Overnight in Grand Junction

Day 2: Shallow marine systems

Classroom:

- Introduction to marine depositional systems and sequence stratigraphy

Fieldwork:

- Parasequences and wave-dominated deltas
- Meandering fluvial

Overnight in Green River

Day 3: Sequence stratigraphy

Classroom:

- Deepwater depstional systems

Fieldwork:

- Sequence boundaries and incised valley fills
- Parasequence correlation
- Recognition and importance of relay ramps, fault seal and deformation bands

Overnight in Green River

Day 4: Tidal systems

Classroom:

- Tidal systems

Fieldwork:

- Fluvial dominated deltas
- Growth faults
- Tidal deposits

Overnight in Green River

Day 5: Summary

Classroom:

- Review of key concepts

Fieldwork:

- Sequence boundaries and incised valley fill
- Parasequence correlation

Overnight in Grand Junction

Day 6: Departure

Departure and travel home.