N116: Structural Geology for Petroleum Exploration *(SW England, UK)*

Instructor(s): Ken McClay

Format and Duration

Field - 5 Days
Low Physical Demand

Summary

This course examines aspects of structural interpretation in different tectonic regimes, from outcrop to regional scale. This is achieved through the use of field examples, petroleum industry case studies, seismic exercises, and scaled analogue modeling examples.

Business Impact: The fundamentals of structural geology are key to **exploration** methods and workflows and in particular the **formation and type of traps**. This course provides participants with the skills and knowledge to **define structural settings** and **characteristics** at basin, play and prospect scales.

Learning Outcomes

Participants will learn to:

1. Appraise different tectonic regimes, to classify fault systems and to understand and evaluate the 4D geometries and evolution of fault systems in different tectonic regimes.
2. Recognize and interpret characteristic seismic expressions of different tectonic regimes as well as evaluate the tectono-stratigraphic sequences associated with different tectonic events.
3. Assess the fundamental geometries of extensional fault systems - planar and listric - in both 2D and in 3D, using analogues and field examples. Characterise fault geometries and fault sequences and their seismic expressions in different extensional environments from rift systems and passive margins to delta systems.
4. Evaluate and identify the distinguishing characteristics of inverted rift basins and the 4D geometric and kinematic evolution of inverted fault systems. Characterise structural styles of inversion and seismic expressions and assess hydrocarbon trap styles in inverted terranes.
5. Evaluate the fundamental dynamics and characteristic structural styles of strike-slip terranes and their 4D evolution. Assess models of 4D evolution of strike-slip fault systems and to recognize the seismic expressions of strike-slip fault systems.
6. Assess the 4D evolution of thrust systems, thrust wedge dynamics and thrust fault-related folds. Characterise structural styles of thrust and fold belts and the characteristic hydrocarbon traps in these terranes. To understand the dynamic evolution of thrust systems using scaled physical models. Interpret seismic sections in thrust and fold belts and to evaluate the 4D evolution of thrust fold systems using the analysis of syn-kinematic growth strata.
7. Critically assess and interpret field outcrops, seismic sections at the prospect and field scale by applying the concepts of geometries, kinematics and 4D evolution as given in this course. Evaluate seismic interpretations and map interpretations of different tectonic regimes.
8. Judge the effects of structural development on hydrocarbon reservoirs – reservoir compartmentalization, sub-seismic scale fault systems, fault and fracture networks, fault sealing concepts and the development of fractured reservoirs.

Training Method

This is a combined field and classroom course based in SW England. Field to classroom time is

approximately 50:50, both comprising lectures, discussion, and practical exercises.

Physical Demand

The physical demands for this course are LOW according to the RPS field course grading system; the course requires basic fitness levels. Walks are typically no more than 4 km along beach sections that can be a little uneven in places. Half a day is spent on a hike of 6 km along the coastal path and along a beach section. There is also a 1 km hike with 100 m elevation change down and back up the coastal path. The field stops are all at approximately sea level and SW England has a temperate climate. All transport is by coach on maintained roads.

Who Should Attend

Geophysicists, geologists, petrophysicists and engineers with an interest in the controls on structure and deformation from basin to play and prospect scale.

Course Content

This course aims to familiarise participants with structural geological principles applied to extensional, compressional, and strike-slip regimes.

The class will cover the following topics:

1. Tectonic regimes; fault systems and fault classifications; fault mechanics, fault rocks and fluid flow.
2. Geometries of extensional faults – planar and listric faults; analogue models of extensional fault systems; rift tectonics and sedimentation; - extensional case histories – Basin and Range SW USA, Gulf of Suez.
3. Inversion tectonics; settings for inversion; geometries of inverted fault systems; 2D and 3D models of inversion structures; case histories of inverted basins.
4. Strike-slip systems; fundamental tectonic settings; 3D kinematic evolution of strike-slip fault systems; analogue modeling of strike-slip structures; natural examples of strike-slip fault systems.
5. Thrust systems; fundamental geometries of thin-skinned fold and thrust belts; kinematics of thrust systems; fault-related folding; growth strata in fold and thrust belts; hydrocarbon traps in fold and thrust belts.
6. Prospect and field-scale structural geology; fault sealing characteristics; sub-seismic scale faulting and fracturing; structural compartmentalisation of reservoirs; fractured reservoirs.

The classroom lectures and presentations will show field, remote sensing, and seismic examples of the key tectonic styles and fault systems. In particular, they will be complemented by scaled analogue models that demonstrate how these fault systems evolve through time.

Classroom lectures and exercises will be complemented by directly relevant superb regional and outcrop examples in the field component of the course.

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Please note that the following itinerary may be modified depending on weather, tide, and light conditions.

Day 0
Participants travel to Dunster. In the evening there is a short introduction and safety briefing before a group dinner.

Day 1. Extensional Tectonics and Extensional Fault Systems I
Classroom lectures, exercises and field excursion.
Introduction to fundamental tectonic regimes; fault geometries and mechanics; extensional fault systems – planar and listric fault systems. Seismic interpretation exercises.
Field excursion – Kilve. 3D seismic scale extensional fault systems.

Day 2. Extensional Tectonics and Extensional Fault Systems II
Classroom lectures and exercises and field excursion
3D extensional fault systems, rift systems, case-histories. Seismic interpretation exercises.
Field excursion – Kilve and Watchet. 3D seismic scale extensional fault systems, relay ramps, and inversion structures.

Day 3. Inversion Tectonics
Classroom lectures and exercises.
Inversion tectonics and inverted extensional fault systems; inversion case histories. Strike-slip tectonics, strike-slip fault systems, analogue models and structural styles.
Seismic interpretation exercises.
Travel to Bude with field excursion to Hartland Quay enroute - Fold and Thrust systems.

Day 4. Strike-Slip Tectonics and Thrust Tectonics
Classroom lectures.
Strike-slip tectonics, strike-slip fault systems, analogue models and structural styles.
Introduction to thrust tectonics.
Field excursion – Bude and Maer cliff - Thrust systems.

Day 5. Thrust Tectonics and Thrust Fault-Related Folding
Classroom lectures and exercises.
Thrust tectonics; thin-skinned thrust systems; thrust fault-related folding; growth strata; analogue models of thrust systems; hydrocarbons and fold and thrust belts.
Field excursion – Widemouth Bay and Millhook Haven. Thrust related fold systems and small scale deformation in thrust systems.

Day 6.
Depart