TETRA TECH RPS ENERGY | TRAINING

N378: Basin Analysis for Petroleum Geoscientists

Instructor(s): Mark Thompson

Format and Duration

Classroom - 5 Days
Virtual - 10 Sessions

Summary

This course examines the tectonic, stratigraphic and sedimentary controls on petroleum systems in sedimentary basins. The tectonic processes generating sedimentary basins, their structural development, the geometry of each basin type and the development of depositional systems within basins are described. Emphasis is placed on the processes that influence the variability of structural styles, their influence on sediment transport pathways and, hence, trap geometry and reservoir predictions. The practical elements of this course involve the use of subsurface data (seismic and well-log) in the interpretation of sedimentary basins.

Learning Outcomes

Participants will learn to:

1. Categorise the general tectonic, stratigraphic and sedimentary controls on petroleum systems in sedimentary basins in generic worldwide settings.
2. Examine the plate tectonic settings, fault geometries, drainage patterns, sediment derivation and facies patterns associated with syn-rift basins formed in continental interiors and beneath passive margins.
3. Categorise the various tectonic controls on trapping styles in petroleum systems formed in post-rift settings (e.g. gravity tectonics; diapirism and drape).
4. Analyse the development and evolution of convergent subduction-accretion and arc-related forearc and back-arc basins and the effects of the volcanic arc products for petroleum systems therein.
5. Analyse the petroleum systems set up in compressional, fold-and-thrust belts and their associated foreland basin settings, subsidence and erosional history, sediment sources and stratigraphic sequences.
6. Illustrate the effects of positive structural inversion in controlling structural styles, fault geometries and their petroleum systems.
7. Verify structural geometries that characterise petroleum systems formed in strike-slip (wrench) settings.

Training Method

A five-day classroom course, including lectures, exercises (seismic interpretation and basin analysis) and discussion. The focus is on regional prospectivity and generalised play types in each basin type. Several case studies are discussed for each basin type.

Who Should Attend

This course is primarily intended for early career geologists and geophysicists in their first six years of working in the oil industry. Technical support staff seeking to increase their geological and interpretation skills will also find the course useful. The course gives a broad overview of petroleum systems in different basin types and can be used as a primer or refresher for specific basin types for more experienced Geoscientists.

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Course Content

The plate tectonic processes generating sedimentary basins, the structural development and the geometry of each basin type are outlined and the development of depositional systems within basins are described. Emphasis will be placed on the processes that profoundly influence the temporal and spatial structural variability of structural styles, their influence on sediment transport pathways and hence, trap geometry and reservoir predictions. This will lead to an appreciation of why it is often difficult to distinguish the effects of tectonic controls from those of other factors (e.g. sea-level changes). The resultant tectonic and stratigraphic evolution is illustrated by means of strategic basin case studies taken from various prospective hydrocarbon provinces to emphasize the impact of this tectono-stratigraphic evolution on the development of petroleum systems.

Attention is focused on integrating sedimentation with stratigraphical architecture and basin dynamics using modern and ancient examples in evolving and mature rift basins and passive margins, foreland basins, convergent margins, structurally inverted basins, salt-prone settings and strike-slip systems. Exercises will incorporate regional seismic lines from a diverse range of sedimentary basins.

Introduction

The ingredients of a successful petroleum system
Classifi cation of sedimentary basins and subsidence mechanisms
Use of seismic stratigraphic methods in structural analysis and petroleum systems

Rift Basins and Passive Margins

- Plate tectonic setting
- Rift Classification (Geometric, kinematic and dynamic)
- Normal fault geometry
- Fault segmentation, growth and linkage
- Role of relay ramps and the concept of transfer zones
- Rift basin drainage patterns
- Sediment derivation, distribution and facies patterns
- Tectono-sedimentary facies models for rift basins
- Sequence stratigraphy in active extensional basins
- Rift-drift transition and the development of passive margins
- Break-up unconformity
- Sediment starved passive margins
- Sediment nourished passive margins
- Post-rift thermal subsidence
- Modification by salt, trapping geometries

Fold and Thrust Belts and Foreland Basins

- Plate tectonic setting

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- General characteristics of fold and thrust belts and foreland basins
- Subsidence and erosional history
- Sediment sources and sediment fill
- Underfilled and overfi lled conditions
- Stratigraphic sequences developed in foreland basins

Subduction and Arc-Related Basins

- Plate tectonic setting
- Trench-slope basins
- Forearc basins
- Intra-Arc basins
- Backarc basins

Structural Inversion

- Plate tectonic setting
- What is structural inversion
- Structural Styles and Fault Geometries
- The importance of Plan view and Cross-sectional geometries
- Timing of deformation and role of fault reactivation: Implications for prospectivity

Basins Developed in Strike-Slip Settings

- Plate tectonic setting
- General characteristics of strike-slip systems
- Classifi cation of strike-slip faults and basins
- Fault patterns and basin geometry
- The importance of Plan view and Cross-sectional geometries
- Extension, subsidence and thermal history
- Transtensional and transpressional basins
- Depositional framework of and characteristic fill of strike-slip basins
- The importance of distinguishing structural inversion from strike-slip – how to do it