7 Training Content - About the Course

7.1 Course Overview
The course discusses common structural styles in sedimentary basins and the geometry and evolution of trap-forming structures associated with extensional, salt, compressive, strike-slip and inversion structures. Examples of trap-forming structures from numerous basins worldwide are used to illustrate the concepts. Problem sets provide hands on experience in interpreting and validating subsurface structures using surface, seismic, and well data.

7.2 Course Content
The course is based on the following content:

1.0 INTRODUCTION
1.1. Role of Structural Geology in E&P
1.2. Concept of Comparative Structural Styles
1.3. Controls of Mechanical Stratigraphy
1.4. Structural Models and Methods in Interpretation

2 BASIC PRINCIPLES AND METHODS
2.1. Fold Geometry and Mechanisms
2.2. Fault Parameters and Interpretation
2.3. Structure Maps
2.4. Structural Cross Sections
2.5. Structural Restoration and Validation
2.6. Kinematic Reconstruction and Structural Evolution
2.7. 3-D Structural Modeling and Interpretation

3 RIFT STRUCTURES
3.1. Evolution of Rift Structures
3.2. Symmetric Graben-Horst Structures
3.3. Rotated Tilt Blocks
3.4. Drape Folds
3.5. Transfer Zones
3.6. Structural Traps

4 LISTRIC GROWTH FAULTS
4.1. Regional Framework of Passive Margins
4.2. Mechanism of Rollover Folding
4.3. Synthetic and Antithetic Faults
4.4. Shale vs. Salt Cored Structures
4.5. Transfer Zones
4.6. Structural Trap Classification

5 SALT STRUCTURES – AUTOCHTHONOUS
5.1. Mechanisms of Salt Tectonics
5.2. Salt Rollers, Pillows, Diapirs, Bulbs and Canopies
5.3. Progressive Evolution of Salt Structures
5.4. Mechanisms – Active Diapirism vs. Downbuilding
5.5. Salt-related Faults
5.6. Classification of Structural Traps
6. SALT STRUCTURES – ALLOCHTHONOUS
6.1. Evolution of Salt Sheets
6.2. Regional vs. Counter regional Faults
6.3. Growth Fault Systems and Mini basins
6.4. Subsalt Structures
7. FOLD AND THRUST BELTS
7.1. Fold and Thrust Geometry and Mechanisms
7.2. Fault-Bend Folds
7.3. Fault-Propagation Folds
7.4. Detachment and Faulted Detachment Folds
7.5. Fold-Thrust Systems
7.6. Structural Traps
8. FORELAND BASEMENT STRUCTURES
8.1. Regional Framework
8.2. First- and Second- Order Structures
8.3. Trishear Models
8.4. Mode I-Basement Structures
8.5. Mode II- Basement Structures
8.6. Trap Styles
9. INVERSION AND REACTIVATED STRUCTURES
9.1. Mechanisms of Inversion and Reactivation
9.2. Characteristic Features- Separation and Growth Features
9.3. Fault-Propagation Folding Inversion
9.4. Fault-Bend Folding Inversion
10. STRIKE-SLIP STRUCTURES
10.1. Distributed vs Decoupled Shear
10.2. Structures Associated with Distributed Shear
10.3. Transpressional Structures
10.4. Transtensional Structures
10.5. Releasing Bends- Pull-Apart Basins

7.3 Objectives
After participating in this course the attendee should understand:

- Correctly interpreting structures in compressional, extensional, strike-slip and diapiric environments.
• How to use characteristic features of structures to interpret structures using geological and seismic data.
• How to locate common structural prospects in hydrocarbon basins
• Use of balancing and reconstruction techniques to improve structural and seismic interpretation

7.4 Who Should Attend
This course is intended for Geologists and geophysicists especially those involved in seismic and structural interpretation or trap-forming structures

7.5 Prerequisites
A general knowledge of basic petroleum geology, structural geology and geophysics

7.6 Course Method
It will be based on power point presentation and practical exercise material.
# Daily Course Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
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<tbody>
<tr>
<td>Session 1</td>
<td>Introduction</td>
<td>Listric Growth Faults</td>
<td>Salt Structures</td>
<td>Fold-thrust belts</td>
<td>Basement – Involved Structures</td>
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<tr>
<td>09:00 – 10:45</td>
<td>Role of Structural Geology in Exploration and Production</td>
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<td>10:45 – 11:00</td>
<td><strong>Morning Break</strong></td>
<td><strong>Morning Break</strong></td>
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<td><strong>Morning Break</strong></td>
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<tr>
<td>Session 2</td>
<td>Basic Principles and Methods- Folds and Faults, Maps and Cross Sections</td>
<td>Listric Growth Faults</td>
<td>Salt Structures</td>
<td>Fold-thrust belts</td>
<td>Inversion Structures</td>
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<td>11:00 – 13:00</td>
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<td>13:00 – 14:00</td>
<td><strong>Lunch</strong></td>
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<tr>
<td>Session 3</td>
<td>Rift Structures</td>
<td>Listric Growth Faults</td>
<td>Salt Structures</td>
<td>Fold-Thrust Belts</td>
<td>Strike-Slip Structures</td>
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<td>13:30 – 15:15</td>
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<td>15:15 – 15:30</td>
<td><strong>Afternoon Break</strong></td>
<td><strong>Afternoon Break</strong></td>
<td><strong>Afternoon Break</strong></td>
<td><strong>Afternoon Break</strong></td>
<td><strong>Afternoon Break</strong></td>
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<tr>
<td>Session 4</td>
<td>Rift Structures</td>
<td>Salt Structures</td>
<td>Compressional Structures – Fold-Thrust Belts</td>
<td>Fold-thrust belts</td>
<td>Summary and Discussion</td>
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<td>15:30 – 17:00</td>
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<tr>
<td>Session 3</td>
<td>13:30 – 15:15</td>
<td>Anderson vs non-Andersonian behaviour, Geodynamic scenario and regional setting set up procedure</td>
<td>Field examples, maps and sections; Seismic examples, lines and time slices; exercises for recognition;</td>
<td>Normal fault systems and fault growth; scale of observation; relays and fault interaction</td>
<td>Inversion structure; types of inversion; recognition of inversion structures; field and seismic examples; implications of inversion;</td>
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<td>15:15 – 15:30</td>
<td>Afternoon Break</td>
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<tr>
<td>Session 4</td>
<td>15:30 – 17:00</td>
<td>Type of fractures and deformational structures, from small scale to regional</td>
<td>Folds and Folding: Fold geometry concepts; Folds and folding mechanisms; Why it is important to recognize fold type and folding mechanisms; Seismic and field examples/exercises; Fold kinematics</td>
<td>Dipmeter Analysis; Image logs and dip; Some types of plots; determining trend and plunge of structural features; exercise</td>
<td>Fractures and fractured reservoirs; stress and strain and types of fractures; Small scale structures;</td>
</tr>
</tbody>
</table>
Appendix A: CV of Instructor – Professor Shankar Mitra

Professor Shankar Mitra
Monnett Chair and Professor of Energy Resources
School of Geology and Geophysics

EDUCATION
Ph.D., 1976, Structural Geology. Johns Hopkins University, Baltimore, MD.

PROFESSIONAL EXPERIENCE

40 Years of Professional and Academic Teaching and Research

University of Oklahoma, Norman, OK.
Monnett Chair and Professor of Energy Resources (1999 to Present).

ARCO Exploration and Production Technology
Senior Exploration Advisor.
1997 - 1999

ARCO International Oil and Gas Company
Exploration Director, Europe.
1994 - 1997

ARCO Exploration and Production Technology
Research Director, Structural Geology (1987-1991)
Research Associate (1986-1987)
Principal Research Geologist (1984-1986)
Senior Research Geologist (1980-1984)
1980 - 1994

Cleveland State University
Assistant Professor.
1976 - 1980

RECENT PUBLICATIONS


RECENT ABSTRACTS

Mitra, S., 2005, Controls of Mechanical Stratigraphy on Fault-Related Folding in Fold-Thrust Belts: Examples from Campeche Bay, Mexico, International Conference on Folding and Thrusting, Beijing, China.

BOOKS


PROFESSIONAL ACTIVITIES

Associate Editor, A.A.P.G. Bulletin (9 years).
Chair, G.S.A. Structure and Tectonics Career Contribution Award Committee, 2005.
Chair of Sessions for A.A.P.G., G.S.A. National, and various International Meetings.

HONORS AND AWARDS


CONSULTING

Continuing Education Course Instructor

Structural and Petroleum Geology Projects

Expert Witness
Chesapeake vs. Marathon, Oklahoma City, 2002