



Applied Structural Geology in Hydrocarbon Systems Analysis

Course instructor: Dirk Nieuwland, PhD.

This practical course is intended for geologists, geophysicists, reservoir engineers and petrophysicists working in E&P. The participants will learn to do geomechanically correct structural interpretations, understand natural fracture networks including the formation of conduits (open fractures) and seals (sealing fractures and faults) in different tectonic regimes.

The participants will be introduced to the main elements of petroleum systems and geo-mechanics, which will serve as a basis for an integrated geological approach. Examples can never give a complete picture, whereas a generic geo-mechanical approach is universally applicable. However, case histories still provide good illustration material which helps understanding the mechanics and will also be used extensively.

In order to create a 'common ground' in the group, the first day will contain fundamental aspects of structural geology and geo-mechanics and the application of this subject to general geological phenomena as encountered in the oil and gas industry. Participants are encouraged to bring actual cases of their current work for general discussion and integrated 'hands-on' problem solving during the workshop. Especially seismic examples are welcome, 'fresh' additions to the workshop material.

A portable sandbox will be used for demonstration analogue modeling of the main tectonic regimes. The course schedule is flexible, as interaction and discussion are given a high priority in this workshop.

Course Program:

Day 1

- Introduction to petroleum systems.
- The role of structures in petroleum systems.
- Fundamental aspects of structural geology and geo-mechanics and its application to general geological phenomena as encountered in oil and gas industry.

Day 2

- Extensional tectonics: rifts, delta's, domes and associated sedimentation patterns.
- Theory, examples, analogue models, structural geometries and fault properties characteristic for extensional tectonic regimes will be treated during the morning session. Structural reservoir types and fault sealing mechanisms will be part of the material.
- Strike-slip tectonics.
- Theory, case history, analogue models, seismic interpretation. Structural geometries and fault properties characteristic for strike-slip tectonic regimes will be treated in the afternoon. Structural reservoir types, in-situ stress analysis and fault sealing mechanisms (also in sand-sand juxtapositions) will be part of the material. The 3D nature of this tectonic setting including pitfalls and traps in structural interpretation will receive special attention

Day 3

- Compressional tectonics: fold-and-thrust belts.
- Compressional tectonics: fault reactivation – multi-phase tectonics
- Theory, case histories, analogue models, seismic

interpretation exercise. Structural geometries and fault properties characteristic for compressional tectonic regimes will be treated in the morning. Structural reservoir types and fault sealing mechanisms will be part of the material. During the afternoon session the mechanics of fault reactivation (inversion tectonics) will be discussed

- Pore pressure prediction and overpressure generation mechanisms.

Day 4

- Diapirs and associated structures
- Fault sealing and top seal integrity
- Aspects of salt-tectonics will be discussed in the morning. Examples from the North Sea and the Gulf of Mexico, including an interpretation exercise. The afternoon session will be used to discuss fault sealing mechanisms and approaches to evaluate top seal integrity in exploration and in production scenarios

Day 5

- Fracture systems: fracture mechanics, reservoir examples and outcrop examples
- Analysis of fault and fracture systems, including fractal properties of fault and fractures and prediction of sub-seismic faults.
- Theory, case histories, analogue models. The morning session will be used to discuss fracture mechanics, fracture types, natural fracture systems and their influence on reservoir characteristics and production strategies.
- Some background information.