



PetroMod* Training

PetroMod training is available from introductory to advanced levels. The courses are usually held at the Schlumberger Center of Excellence - the *PetroMod* headquarters - in Aachen, Germany or in Houston, TX, USA.

General Information

- Number of participants is limited to 8/12 persons (advanced/basic courses).
- Experienced *PetroMod* geoscience staff members conduct the courses.
- Full documentation is provided.
- Hardware is provided for two persons per computer. However, we recommend each participant to bring a notebook computer, if possible with the Windows XP/Vista or Linux operating systems. The entire *PetroMod* 1D/2D/3D software suite will be installed on each PC.
- Course fees do not include travel and accommodation expenses. We are happy to help with hotel reservations and can advise on travel arrangements.
- You do not have to be a *PetroMod* user to attend the basic courses.

Basic *PetroMod* Training: 1D, 2D, 3D

Duration: 5 days
Who should attend: New users but also a good refresher course if you have not used *PetroMod* for a while. It offers an **introductory** review of the workflow of 1D/2D/3D packages with hands-on exercises.

PetroMod 1D

- *PetroMod* 1D introduction and workflow exercises: input data and boundary conditions.
- Entering calibration data using the Well Editor and calibrating models.
- Introduction to editors: creating and editing lithotypes.
- Some special tasks: erosion editing, etc.

PetroMod 2D

- Building 2D sections from various data sources: seismic, well data, geologic sections.
- Creating and editing horizons and faults.
- Assigning properties: lithofacies, organofacies, geologic ages, QC and pitfalls.
- Running the simulator.
- Analyzing results (output modules) and extracting data, for example to 1D.

PetroMod 3D

- Constructing 3D models from maps.
- Editing horizons and faults.
- Assigning properties and geologic ages, QC and pitfalls.
- Running the simulator.
- Analyzing results (output modules) and extracting data to 1D, 2D, and map viewers.

Including information and overview on:

- Litho Database.
- Kinetics and Components.
- Local Grid Refinement and Seismic Facies Refinement.
- Fluid Calibration and PetroFlash.
- Heat Flow Calibration and Crustal Heat Flow Tool.
- Sensitivity Analysis and Risking.
- Using structural models (TecLink 2D, 3D).
- Heatflow Calibration and Crustal Heatflow tools.
- MapEditor and *PetroMod Express*.
- PetroMod-Petrel Data Exchange Plugin.

Pressure Calibration in Petroleum Systems Modeling (PSM) in *PetroMod*

Duration: 3 days
Who should attend: *PetroMod* users of all levels.

Understanding pore pressures in the subsurface is of great importance during all stages of hydrocarbon exploration and production. During the evolution of a sedimentary basin, the pressure conditions have an influence on source rock maturation, migration paths, reservoir porosity and permeability, seal capacities, and ultimately on the prediction of hydrocarbon reserves. When pre-drilling a prospect, understanding the risk of high overpressures is a great benefit for ensuring a safe and successful well design.

This course covers all relevant theoretical background knowledge necessary for understanding how overpressures can develop in sedimentary basins. Equipped with this knowledge, you will learn how to calibrate a 3D Petroleum Systems Model for porosity and pore pressure. Once the model has been calibrated against present day measured porosity and pore pressure values, it is possible to make predictions about undrilled parts of the modeled area. Fully PVT controlled fluid flow simulations let you predict accumulated hydrocarbon compositions and properties (API, GOR).

This course is designed for *PetroMod* users of all levels. All necessary model-building skills will be covered in class. After attending this class, you will be able to greatly improve your Petroleum Systems Models and understand how to increase their predictive potential.



Structural Analysis for Petroleum Systems Modeling (PSM)

PetroMod modules: TecLink 2D, 3D
Duration: 3 days
Who should attend: Novice or experienced basin modelers

Sedimentary basins in which we explore for hydrocarbons are the result of structural processes at all scales. Accommodation space for the sediments is primarily created by structurally and thermally induced subsidence. The structural evolution of sedimentary basins not only controls the sediment deposition, but also forms structural traps and pathways for hydrocarbons. An understanding of the timing of structural activity during the development of the petroleum system is of great importance for exploration success. Tectonic development in salt basins can be very complex. Unique physical properties and a strong influence on depocenter distribution make it necessary to understand the dynamics of salt movement. Quantification of salt movement in time and space will enable us to better understand the petroleum system in these basins.

In order to populate a PSM, we need to understand the structural evolution of the basin. This will enable us to quantify paleo-heat flows and paleo-water depths. It will also help us to define interpolations of facies distributions and to define fault properties for migration. In areas of strong compressional tectonic deformation, like fold and thrust belts or toe-thrust regions of passive margins, the definition of paleo-geometries is a prerequisite for understanding the maturities and migration pathways of the petroleum system.

This 3-day course will update the petroleum systems modeler (novice or experienced) in structural basin analysis and will showcase in key applications how structural information is implemented in PSM in extensional and compressional (TecLink technology) terrains as well as in salt basins. Case studies in 2D and 3D will allow participants to quickly learn how to integrate structural information with a BPS numerical model. Also key pitfalls and (data) limitations will be discussed during this course.



Quantification of Uncertainty Analyses in PSM

PetroMod modules: PetroRisk
Duration: 2 days
Who should attend: Anyone familiar with the basics of *PetroMod* basin modeling who also comprehends the fundamental principles of statistics.

The course will give you a general overview of risking using PetroRisk. The course will cover the fields of basic statistics, uncertainty analysis in model building and model calibration. A combination of theory and practical exercises will be used to evaluate the impact of uncertainties in input data on individual models and to understand the dependencies and correlations between geological processes and model uncertainties.

During the model building process the following questions may arise:

- How strongly do uncertainties in the data affect temperatures and pressures?
- How sensitive does hydrocarbon generation timing react and how meaningful are the results of the petroleum migration modeling?
- Are the results representative of the range of possible values of the variables, or do they only show one of a very wide range of possible outcomes?
- Which set of input data leads to agreement with the measurement data?

After completing the course, *PetroMod* users should be able to answer the above questions.

Upon completion you will also be able to:

- Navigate the PetroRisk user interface.
- Import and edit input uncertainties.
- Perform statistics runs and evaluate output results.
- Populate the model with risk points for which output results will be stored.
- Carry out a risk data analysis using 1D, 2D and 3D Viewer.
- Calibrate your model to fit measured values.
- Develop workflows for risking and calibrating your model.



Petroleum Resource Assessments with Special Reference to Petroleum Systems Modeling

Duration: 3 days

Who should attend: Members of national hydrocarbon authorities, national oil companies and all petroleum geoscientists interested in advanced methodologies for petroleum resource assessments.

Course contents:

1. Definitions and rationale for petroleum resource assessments:

What are petroleum resource assessments, why are they essential and what is their potential economic impact and value?

2. Methods applied for petroleum resource assessments:

Which methods are commonly applied for resource assessments, do generally accepted standards or references exist, which organisations play a key role in resource assessments and what are their approaches?

3. Conventional and unconventional petroleum resource assessments:

What is the status of and the differences between resource assessments for conventional hydrocarbons (in conventional oil and gas accumulations), and unconventional hydrocarbons such as shale gas, oil/tar sands, coal bed methane (CBM) and gas hydrates?

4. An introduction to advanced petroleum systems modeling methods:

What is petroleum systems modeling, what is its role in resource assessments and how can it help to improve the quantification of petroleum resources including the assessment of uncertainties?

5. Applications and case histories of petroleum systems modeling for petroleum resource assessments:

Applications of petroleum systems modeling for petroleum resource assessments will be shown in detail for examples ranging from frontier exploration areas with no or only very few wells, to well explored areas with high risks (e.g. offshore), and to very mature areas where yet-to-find potential is assessed. A particularly detailed workflow presentation will show the development of a complete resource assessment performed by the USGS using advanced 3D petroleum systems modeling.

6. Technical requirements for petroleum resource assessments using petroleum systems modeling:

What are the technical requirements that petroleum systems modeling tools (both software and hardware) need to meet in order to be usable for petroleum resource assessments?

7. Data requirements and workflows for resource assessments using petroleum systems modeling:

What types of data and data densities are required for resource assessments based on petroleum systems modeling, how are the data models constructed and processed, how are uncertainties of the results affected by uncertainties in the data and how can these be quantified and displayed?

8. Ongoing and future R&D work in petroleum systems modeling and its ramifications for both conventional and unconventional hydrocarbon resource assessments:

In this outlook, technical development work in specific areas of petroleum systems modeling which are relevant to hydrocarbon resource assessments will be presented. This will include Local Grid Refinement (LGR) methods which enable much more flexible handling of geological data models and the included petroleum systems, resulting in improved quantifications of hydrocarbon resources.



Exploration and Development Geochemistry

Duration: 3 days
Who should attend: Primarily exploration geologists, also geochemical coordinators, managers, and development geologists.

This applications-oriented 3-day course shows how geochemistry can reduce the risk associated with petroleum exploration. It is designed for exploration geologists, but could also benefit geochemical coordinators, managers, and development geologists. The course provides interpretive guidelines to evaluate prospective source rocks and define petroleum systems. Examples of the application of geochemistry to production problems are given. Discussions cover the following tools: TOC, Rock-Eval pyrolysis, vitrinite reflectance, thermal alteration index, kerogen elemental analysis, geochemical logs and maps, reconstructed generative potential calculations, and gas chromatography. Sample collection techniques are discussed. Pitfalls to correct interpretations are illustrated using in-class exercises. Biomarkers and advanced isotopic and diamondoid tools are introduced and worldwide case studies are given to illustrate interpretive methods.

Objectives:

- Understand the basic concepts of petroleum geochemistry .
- Understand basic geochemical measurements, e.g., Rock-Eval pyrolysis/TOC, vitrinite reflectance, including interpretive pitfalls.
- Learn how to reconstruct the original petroleum generative potential of spent source rock.
- Identify the elements and processes that control petroleum systems and how they are quantified.
- Learn how to collect oil and rock samples and how to evaluate data quality.
- Learn how biomarkers and isotopes are used to correlate oils and source rocks and assess thermal maturity and biodegradation.
- Gain geochemical expertise based on case studies and exercises to allow better communication with colleagues and clients.



Calibration Workflows in PSM

Duration: 3 days
Who should attend: Entry-level basin modellers and *PetroMod* users, as well as intermediate Petroleum System Modellers who want to refresh their knowledge of the principles and workflows of calibration in Petroleum Systems Modeling.

Petroleum Systems Models are based on present day data. Following the basic principles of actualism and fundamental physical laws, the geologic history of a basin is reconstructed. To be able to make predictions about unknown or uncertain regions of this particular basin, where only little or no direct data is available, the present day situation must be understood as fully as possible.

Adding measured data from wells to a Petroleum Systems Model and adjusting the input parameters of the model in a way that the results match this data will ensure that the model optimally reflects all known present day data. The process of calibration is to adjust your input model in such a way that the calculated model results match the measured well data. The model will be only as good as your input data, so the better calibrated your model, the more predictive and useful it is for exploration.

When this is the case, certain assumptions can be made about the properties of rocks through time and their reaction to burial and, for example, about the formation of hydrocarbons by maturation of organic rich source rocks and migration of produced fluids to structures which were formed during the geologic history of the basin. This helps to define regions with high uncertainties and regions where the geological setting is well known.

Calibration is therefore an essential step in the construction of a basin model for dealing with input data uncertainty.

Calibration of a Petroleum Systems Model covers thermal, pressure and hydrocarbon property calibration as well as the sensitivity analysis of hydrocarbon occurrence in well-explored areas. This course will focus on thermal calibration, pressure calibration and hydrocarbon property calibration. In the course, participants learn related theoretical aspects and calibration workflows, and will be introduced to the limitations and pitfalls of calibration and calibration data.

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