

PetroMod 2D Software

Full petroleum systems modeling in two dimensions, plus time

PetroMod* petroleum systems modeling software combines seismic, well, and geological information to model the evolution of a sedimentary basin. PetroMod software will predict if, and how, a reservoir has been charged with hydrocarbons, including the source and timing of hydrocarbon generation, migration routes, quantities, and hydrocarbon type in the subsurface or at surface conditions.

PetroMod 2D software is primarily applied in areas with sparse data—for example, if the data is only sufficient to construct a 2D geologic section. PetroMod 2D software is also routinely applied in areas with dense data coverage, when rapid analysis is desired, and for pressure prediction work.

Modular software system

Configure the PetroMod software system that suits you best by selecting the required modules in five steps:

1. **Select the 2D model builder** to work with 2D data (cross sections).
2. **Select the type of pressure temperature simulator**, either multi-1D for fast, quick-look work, or full 2D/3D for more accurate modeling.
3. **Select the type of kinetics**, either two-component kinetics (oil and gas), which is often used if no direct source rock data is available or for initial screening work, or multicomponent kinetics, which provides accurate petroleum property predictions.
4. **Select the type of petroleum migration simulator**, either flow path for fast high-resolution simulations for screening work, invasion percolation for high-resolution simulations (e.g., in locally refined grids), or hybrid for the most accurate method.
5. **Select the optional add-on modules** to address specific modeling tasks.

Model builder

PetroBuilder 2D: The basic PetroMod 2D module for building 2D, cross section–based petroleum system models. PetroBuilder is the fundamental input module for defining properties (such as geometry, facies definitions, and boundary conditions) of a 2D PetroMod petroleum systems model.

Pressure temperature simulation

Two modules for pressure and temperature calculations are available for PetroMod 2D modeling:

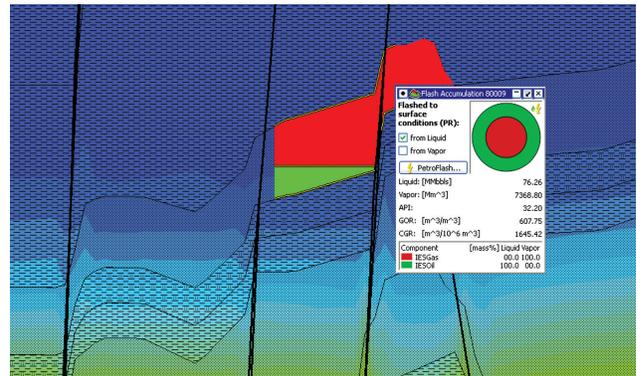
- **Multi-1D:** A basic pressure and temperature module, enabling fast multi-1D pressure, temperature, and maturation simulation engine for screening work and basic assessments of the temperature history of a petroleum system.

Full 2D: A simulator to perform full 2D pressure, temperature, and maturation simulations to determine temperature and pressure distribution on different scales (basin, prospect, and reservoir), including transient effects and lateral inhomogeneities in facies and flow.

Kinetics

To investigate source rock hydrocarbon generation, kinetics methodology must be added to the input and simulation modules. For initial assessments basic, two-component kinetics is offered. For more sophisticated phase and property hydrocarbon predictions, multicomponent kinetics should be chosen.

- **Two-component:** Basic oil and gas kinetics (black-oil model) for modeling in areas with no direct source rock information or for fast screening work.
- **Multicomponent:** Advanced kinetics for highest accuracy in petroleum property predictions with user-defined numbers of components.



Hydrocarbons flashed to surface conditions; info box shows API gravity, GOR, and condensate gas ratio.

Petroleum migration simulators

To complement the chosen kinetic module, PetroMod software offers three migration modules: a flow path ray tracing–based module for fast migration modeling that only takes buoyancy into account; an invasion percolation module that is driven by a cell–based buoyancy and capillary pressure; and a full hybrid migration module that combines flow path–based migration in high–permeability materials and darcy migration in low–permeability layers, providing the most accurate PetroMod migration modeling.

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- **Flow path:** Fast, high-resolution petroleum migration modeling used for screening work; also suitable for areas with clearly defined regional carrier systems.
- **Invasion percolation:** Fast, high-resolution modeling in which inversion workflows have been applied to define high-resolution facies maps or in which locally refined grids are used.
- **Hybrid:** Advanced migration modeling technology that uses multiple methods, including darcy to provide pressure control and flow path for efficient processing in good carriers.

Add-ons:

- **PetroRisk* module:** Enables rigorous risk and uncertainty analyses of PetroMod data, with multiple uncertainties and a full set of statistical evaluation tools.
- **TecLink:** Loads paleo-sections or models from structural reconstructions, and then performs thermal history and petroleum migration modeling in the most complex geological environments, such as fold and thrust belts, with no functional limitations on the simulations.
- **Parallel processing:** Improves performance on multicore Linux® and Windows® systems.
- **14-component phase kinetics:** Developed in cooperation with the GFZ Potsdam research institute, improves petroleum phase predictions.
- **Geomechanics:** Allows the definition of elastic properties of lithologies to simulate the stress and strain field of the model.
- **Gas hydrates:** Simulates and displays the stability zone of gas hydrates through time.

Prediction of petroleum generation

PetroMod software uses a database of reaction kinetics to predict the phases and properties of hydrocarbons generated from source rocks of various types. In addition, adsorption models describe the release of generated hydrocarbons into the free pore space of the source rock.

Advanced petroleum migration technology

- Fully PVT-controlled modeling of n -component/three-phase relationships during the entire migration process—PetroMod software is the only commercial system with this advanced tool.
- Advanced handling of component/phase relationships using flash calculation technology to deliver an improved understanding and prediction of petroleum properties and oil-versus-gas probability assessments.
- Sophisticated source rock tracking—multiple source units can be defined, and each unit can have unique kinetics and generate multiple components.

Four migration simulation methods

- **Darcy flow:** Describes multicomponent, three-phase flow based on the relative permeability and capillary pressure concept. Migration velocities and accumulation saturations are calculated in one step.

- **Flow path:** Simulates lateral petroleum flow, which occurs instantaneously on geologic time scales in high-permeability layers. This can be modeled with geometrically constructed flow paths to predict the locations and compositions of accumulations; the spilling between and merging of drainage areas is taken into account.
- **Invasion percolation:** Assumes that on geologic time scales, petroleum moves instantaneously through the basin driven by buoyancy and capillary pressure to better model fluid flow in faults. The invasion percolation method can use high-resolution facies maps (e.g., from seismic inversion workflows) or special controls to mimic capillary pressure heterogeneity.
- **Hybrid (darcy, flow path, and invasion percolation):** Enables detailed, high-resolution models to be processed with sophisticated full-physics technology, accurately simulating the relationship between hydrocarbon column heights and seal breakthroughs.

Advanced technology

- Facies refinement to directly incorporate high-resolution facies distributions, based on seismic data.
- Most complete range of special modeling tools, such as salt and igneous intrusion.
- Fully integrated 1D, 2D, and 3D interface and simulators.
- Consistent data formats on all platforms and operating systems.
- Ability to use multiple simulation methods on the same data model.

PetroMod software provides a standardized user interface across the entire 1D, 2D, and 3D software suite. It uses the same simulators in 1D, 2D, and 3D; all technical features and tools are available and identical in all dimensions, ensuring full compatibility across the suite.

Specifications

PetroMod software is available on all hardware platforms running Microsoft® Windows XP Professional (32-bit), Windows Vista® (64-bit), Windows 7 (64-bit), or Red Hat® Enterprise Linux® 5.3 (64-bit) operating systems. PetroMod software provides the same interface, functionality, and binary data formats on all platforms so that input/output files can easily be transferred within mixed hardware systems.

Schlumberger Information Solutions

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