TECHNICAL SPECIFICATIONS

TemisFlow™

Basin Modeling &
Petroleum System Modeling

Software Presentation

TemisFlow™ is the best-in-class solution for multi-dimensional basin modeling. Built upon 30 years of R&D for numerical modeling of petroleum systems, it enjoys a unique reputation for scientific rigor and sound physical basis.

TemisFlow™ unified workflow offers the following key stages:

- Present day model building (1D, M1D, 2D, 3D)
- Restoration through time
- Simulations (temperature, maturity, expulsion, pressure, migration)
- Calibration
- Post-Processing

TemisFlow™ applicability ranges from regional resources evaluation and play assessment, prospect generation and ranking to pre-drill risk assessment, including drilling optimization in overpressured areas. TemisFlow™ has also expanded its capabilities to address energy transition needs such as deep geothermal energy, basins' natural hydrogen potential, and CO2 storage.

Functionalities & Algorithms

SCENARIO MANAGER

- Step by step workflow
- Tracking of the modifications and hypothesis through a Scenario Tree
- No duplication of unmodified data

GEOLOGICAL FRAMEWORK AND GRID

- 1D, M1D, 2D or 3D
- User-defined extractions to build consistent simulation grids
- Task manager for quality control and automatic corrections
- Interactive 2D and 3D edition
- Easy to update

BACKSTRIPPING

- Interactive backstripping decoupled from simulation
- Visualization of the grid evolution through time in pre-processing

ADVANCED RESTORATION PROCESS

- Hiatus and multiple erosion events
- Multi-layers thickness variations
- Multiple lithology changes through time

SALT RESTORATION

- Multi-layer Thickness Variations and/or Lithology Changes Events for salt diapirism and canopies development
- Direct volume computation from thickness maps for QC
- Automatic routine based on basin regional tectonics and accounting for sediment loading effect on diapirism

MAP EDITOR

- Handles horizons, property maps, clouds of points and grids
- Multi map visualization
- Interactive drawing, painting, and mesh edition
- Multiple variable operations, attributes and mapping computations: interpolation, smoothing, normalization, gradient, curvature...
- Fault digitalization as polylines or polygones

STRUCTURAL CLOSURE AND DRAINAGE AREAS COMPUTATION

- Fast and direct computation on maps (structured or unstructured horizons)
- Accounts for reservoir porosity and thickness, as well as faults
- Filtering and reporting on traps of interest
- Possibility to export as polylines all generated traps and drainage areas

LITHOLOGY MANAGEMENT

- IFPen databank with reference lithologies
- Creation of user-defined or mixed lithologies
- Possibility to tune and define:
  - Depth-compaction curves
  - Permeability (thanks to Kozeny Carman, log(K) or user defined laws)
  - Thermal conductivity and radiogenic production
  - Relative permeabilities and capillary pressure curves

DIAGENESIS

- Chemical compaction for sandstone and chalk through pressure-dissolution phenomenon
- Chemical compaction for mudstone with dissolution of kaolinite or smectite, transport and mineral precipitation of illite

GEOCHEMICAL INFORMATION

- Laterally variable Initial TOC, Initial HI and Net to Gross for each Source Rock
- IFPen or BP schemes with their associated databank
- Definition of all kinetics parameters for HC fractions and Source Rocks (viscosity, thermal reactivity, phase behavior...)
- User-defined multi-compositional HC systems and kinetic schemes
- Primary and secondary thermal crackings
- User-defined Vitrinite-Transformation Ratio law

UNCONVENTIONAL RESOURCES

- Computation of adsorbed HC quantities controlled by TOC evolution, pore pressure, temperature, kerogen kinetic, carbon mass balance and HC density
- Organic porosity calculated according to kerogen cracking
- Both processes fully coupled with expulsion and Darcy's migration simulations

BIOGENIC GAS

- Definition of labile (available to microbial activity) and labilizable (requiring a preliminary maturation) organic matter to assess biogenic gas generation
- Adsorption, dissolution and free transport of the biogenic gas
- Fully coupled with thermogenic processes

BIODEGRADATION

- Biodegradation process fully coupled with Darcy's migration
- Sensitivity to biodegradation definition for each component
- Bacterial activity controlled by temperature and pore space
- HC phase composition and viscosity affected throughout migration process

INTERNAL SOURCE POINTS

- Definition of time-dependent sources to model deep gas sources (CO2, H2, He, H2S...) or CO2 injection
- Possibility to tune depth, location, and generated amount of sources
- Specific dissolution laws for generated gas (CO2, H2S, H2, and He)

HYDRATES AND TSR OCCURENCE RISK

- Risk given in residence time in the favorable window
- Computed for all cells and at all ages of the grid

THERMAL BOUNDARIES

- Several conditions: surface temperature, temperature at base upper mantle, temperature gradient, heat flow at base sediments or base upper mantle

BeicipFranlab

- Automatic computation of surface temperatures from paleobathymetry and paleogeographic position during continental drifting
- Extraction of heat flow values at base of sediments from a simulation with advanced basement to remove the crust and reduce computation time

ADVANCED THERMAL BASEMENT
- McKenzie or user-defined approach
- Complete description of the lithosphere accounting for heterogeneities both in structure and nature
- Homogeneous or heterogeneous rifting (geometric and thermal beta factors)
- Lithology changes through time
- Coupling of the lithosphere with the sedimentation of the model
- Strong thermal conductivities heterogeneities handling
- Blanketing effect modeling

LATERAL BOUNDARIES
- User-defined boundaries to assign specific pressure and temperature conditions at the model edges through time
- Several pressure types to define: No Flux, Hydrostatics, Water-Head, Constant Pressure or Overpressure

PIEZOMETRIC SURFACES
- Definition at each time step of the water table depth
- Handles arid areas (below Sea Level) and lakes (above Top Sediment)

GEOMECHANICAL STRESS
- Definition of the basin horizontal deformation, in extension or shortening, at each time step
- Automatic assessment of the corresponding horizontal stress with impact on porosity, permeability, and pressure computation

FULLY COUPLED AND PARALLELIZED SIMULATIONS
- Temperature, Pressure, Expulsion, decoupled or full Darcy Migration
- Non-compositional or multi-compositional simulations
- PVT computation through time
- Tuning of time steps and simulation control criteria
- Possibility to use temperature regime from a previous simulation
- Parallelization on several processors

MAP BASED RAY TRACING SIMULATION
- Traps and drainage areas computation through time
- Accounts for basin deformation history
- Multiple source rocks and multiple reservoirs
- Accounts for petrophysical properties, lateral variations, stratigraphic trapping and faults
- Based on expulsion or migration simulation to predict trapped Gas/Oil volumes with API degree, GOR and column height
- Upward or downward migration from source rock layers

Results Analysis

THERMAL AND MATURITY PROPERTIES
- Temperature regime and recoverable heat in place
- Maturity indicators: Vitrinite Reflectance, Tmax, S2
- Various TOCs: Rock-Eval TOC, Current TOC, Residual Solid TOC
- Source Rock Maturity Timing

PRESSURE PROPERTIES
- Water Pressure and Overpressure
- Mud Weight
- Effective Stress (lateral and vertical components)
- Hydraulic Fracturing

EXPULSION AND MIGRATION PROPERTIES
- Adsorbed and retained masses
- Expelled and Migrated masses in free and dissolved phase
- HC Phase Saturation
- Biodegradation Index
- PVT properties: Volumes, API Degree, BO, BG...

CO2 STORAGE SITE CHARACTERIZATION
- Risk assessment for site identification
- Plume and dissolved CO2 volumes
- Long-term pressure pertubartion

NATURAL H2 AND ACID GASES
- Free and dissolved volumes in place

BUNCH OF VISUALIZATION TOOLS
- 3D Viewer
- Map Viewer
- Cross Plot Viewer
- Cross Section Viewer
- Log Viewer
- Statistics Viewer

DATA EXTRACTION & CALIBRATION
- Map extractions
- Well extractions
- Burial analysis
- Log pressure analysis
- Cell history
- Section extractions

FILTERING & REPORTING
- Filtering capabilities on simulated output
- Synchronization between viewers
- Statistics and quantitative report on areas of interest

Data Management

DATA IMPORT/EXPORT
The following formats are available:
- Horizons in ASCII cloud of points, CPS3 ASCII and binary, Fraca, GMap, gOcad TSurf and Z-Map+
- Property maps in ASCII cloud of points, CPS3 ASCII and binary, Fraca, GMap and Z-Map+
- Cultural data in shape files and .leg format
- Polylines in ASCII, CPS3 and Z-Map+
- Well paths and logs in ASCII, LAS 2.0 and 3.0, and OBDAT2
- Faults in CPS3 ASCII and binary, Fraca, EarthVision, gOcad TSurf and Z-Map+
- 2D section templates in .ext format and flat file
- Lithology and geochemical libraries in .xml and .ltds formats
- Stratigraphic scales in .temis format
- Temis Suite studies (1D, 2D, and 3D)
- Seismic in XML and SEG-Y
- 3D grid in GRDECL and RESQML
- Templates, preferences and color scales from OpenFlow™
- Groovy scripts and packages
- Data exchange between OpenFlow Suite projects

DATABASE
- MySQL or Oracle database
- Improved data security and integrity, reduced data storage
- User and project administration

OTHER PLATFORM FACILITIES
- Colorscale & unit system management
- Remote machines or cluster simulation launcher
- Simulation monitoring
- Online & contextual Help

Extensions & Customization

- Direct link with CougarFlow® for sensitivity and risk analysis and assisted calibration
- Direct link with DionisosFlow® for elaborate facies, kerogen, and paleobathymetry maps
- Direct link with KronosFlow™ for advanced 2D restauration in structurally complex environment
- Petrel link for direct maps, wells, faults and grids exchange
- Scripting facility based upon Groovy language

System Requirements

- **Operating Systems**:
  - Supported on Windows 10, Compatible with Windows 11
  - Linux Red Hat 7 and Red Hat 8 for calculators only (unavailable GUI)
- **RAM**: 48 Gb or more recommended, 32Gb minimum
- **Minimum free disk space**: 5 Gb (for installation files)
- **CPU**: x86-64 processors (Opteron, CoreDuo, Core2Duo, Xeon & EMT64, Nehalem, Westmere, Sandy Bridge, Core i3, i5, i7)
- **Dualcore or Quadcore**: 2 GHz or more recommended
- **Graphics board**: NVIDIA (except Quadro FX 1000, Quadro FX 3500, Quadro NVS 110 M, Quadro NVS 280 SD and NVS 300) with recent driver (at least OpenGL 3.3 -driver 330 or later)
- Openmotif rpm package must be installed on Linux
- **Database**: MySQL 5.5, 5.6.X (with X superior to 22), 5.7 or 8.0 and Oracle 12c, 18c or 19c
- FlexLM 11.16.2 server for licensing

Beicip-Franlab Headquarters
232, avenue Napoléon Bonaparte
92500 Rueil-Malmaison - France
Tel.: 33 1 47 08 80 00
Email: info@beicip.com

BeicipFranlab
An **IFP group company**