Permedia MPath – Feature Summary

MPath, from the Permedia Research Group Inc., bridges the worlds of basin and reservoir modeling, providing a rich set of tools for simulating processes that occur at regional, basin and reservoir scales. MPath's visualization and data analysis tools support more than 100 file formats, enabling modelers to integrate basin and reservoir data in a single environment. MPath is available on all major platforms.

MPath for basins

For basin modelers, MPath's basin tools provide the ideal toolkit for quantifying volumes and fluid properties, and evaluating petroleum containment potential and emplacement patterns. And the same set of tools can be used to evaluate petroleum flow and emplacement ranging from core to basin scales. Easy to use, with similar workflows at each scale of investigation, MPath can model 3D, multi-scale, multi-million gridcell petroleum transport in a matter of minutes.

Petroleum migration

With close to ten years of development, Permedia's basin-scale migration solvers are unmatched in speed and sophistication. The first commercial solver to use modified invasion percolation algorithms to simulate migration and reservoir filling, MPath's high-resolution petroleum migration simulator rapidly simulates multi-phase flow behavior in porous, faulted and fractured media to predict petroleum migration trajectories and highly detailed petroleum emplacement patterns. Features include:

- **Speed.** MPath Migration runs in a fraction of the time of other simulators and works in both 2D and 3D. Simulations of complex models run in just minutes to a few hours.

- **Native mesh support.** Run simulations on native PetroMod, Temis, Gocad and other meshes, without any conversion. Adding support for additional mesh types is straightforward.

- **Multi-component.** MPath Migration's transport algorithms are designed from the ground up to handle multi-components using a flexible reactants and reactions scheme.

- **Tracers.** MPath Migration's sophisticated tracer scheme allows you to track component origins based on facies, layer, category maps, or any property. The new Genetic tracers system lets you identify the pedigree of petroleum in any given accumulation and calculate loss rates between source and trap.

- **Secondary cracking and biodegradation.** Model the effects of secondary cracking and biodegradation. Added in collaboration with the Bacchus 2 Consortium at the University of Calgary, MPath Migration incorporates the very latest technology for simulating the effects of biodegradation on petroleum migration.

- **Reaction Plugins.** Add your own, proprietary fluid-fluid and rock-fluid reactions to Migration using the free, multi-platform reaction plugin software development kit. Proprietary Source Rock models and PVT calculators can also be created via this kit.

- **Mesh overrides.** Use any basin mesh as a “base case” and create multiple source and seal scenarios as input to Migration, without re-running the original basin model. This can literally save days of project time.

- **Multi-threaded.** MPath Migration is designed to take advantage of multi-core processors.
Basin P/T features lithology proportion maps, flexible pressure and temperature boundary conditions, interactive modeling, calculator plugins and flexible rock property tools. Basin P/T supports models built outside of MPath (e.g., Petrel, Gocad).

**Map-based tools**

MPath includes sophisticated, map-based tools for conducting fetch-closure, trap volume and fill-spill analysis. Each of these tools are “fluid-aware”, going beyond other geometry-based tools.

**Basin Pressure/Temperature**

Forward model pressures and temperatures in an evolving mesh with MPath Basin P/T. Coupling a flexible calculator that uses the latest mathematics and computational efficiencies with rapid model building workflows, Basin P/T allows you to model basin geometries and lithologies through time to create sophisticated 2D and 3D models quickly and easily.

**Evaluate basin pressure and temperature evolution**

Couple Basin P/T with MPath's petroleum generation and expulsion modules to create inputs into the Migration simulator for a complete basin modeling workflow.

**Fetch-closure and fill-spill analysis**

Fetch-closure analysis can be performed on time-based basin models, providing information on fetch and closure stability through time.

**Closure-stability maps (closure and fetch through time)**

Using Migration for a reservoir filling study
**MPath for reservoirs**

MPath's reservoir tools fill the gap between basin and reservoir simulation: while basin models lack the resolution to understand detailed filling processes, and classical reservoir simulators are not designed to handle geological timescales, MPath's reservoir tools integrate reservoir and basin workflows. For reservoir engineers, MPath Reservoir tools provide insights into observed composition variations, fluid continuity assessments, and pressure/fluid property compartmentalization. For basin modelers, MPath Reservoir tools enable the simulation of detailed reservoir charge and filling models that honor the controlling physics and fluid chemistry.

MPath's reservoir tools are the product of Permedia's research and development consortium, tasked to develop a set of full physics, reservoir filling and mixing simulators.

**Pressure and Tracers**

MPath Pressure and Tracers generates a pressure and velocity field from any volume (structured or unstructured mesh) with sources and sinks (typically injector and production wells). Dope fluids with any number of numerical tracers to track the movement of the fluids. Typical applications include evaluating dynamic connectivity of geostatistically-generated reservoir models, identifying pressure compartmentalization, pre-screening reservoir models prior to full production simulation and for many ground-water flow applications.

Using Pressure and Tracers to perform “pressure seeding”, you can take a volume- or mesh-based model and seed it with known pressure (or overpressure) values. The system is then allowed to “relax” and the pressure field will then adjust according to the permeability fabric. Pressures at the seed points (or wells) are held constant.

The results of the pressure simulation can then be integrated with your basin and seismic-based pressure models using Pore Pressure Integration.

**Two component miscible mixing**

MPath Fluid Mixing can take any two end-member fluids and mix them according to their responses to convection, diffusion and dispersion. The fluids are assumed to be miscible, but may be compressible. Applications include the mixing of two distinct oils, querying gravity segregation and convection drive during reservoir filling and injecting CO₂ into saline aquifers.

**N-component mixing**

Fluid Mixing includes n-component and multi-phase support. This tool is effectively a compositional reservoir simulator, although one that speaks the language of petroleum systems modelers. This full-physics simulator is designed to model reservoir filling and mixing processes that can take place over hundreds of thousands, or millions of years. Processes such as molecular, pressure and thermal diffusion are included. Links with Migration make it the ideal tool for understanding filling and mixing behavior.

**Black Oil**

MPath Black Oil is a black oil production simulator. Modelers can take Migration output, charge detailed reservoir models using the Mixing simulators, and pass the results to MPath Black Oil.
Pore Pressure Integration

Pore Pressure Integration is a powerful new platform for deriving pore pressure from 3D data. Pore Pressure Integration can be used to calculate pore pressure from 3D seismic velocity data, integrate pore pressure data from multiple sources, or perform both operations in the same volume concurrently – all in a single screen.

Pressure modelers can implement their own calculators using equations or scripts. Calculation results can be viewed interactively in the 2D or 3D viewers, and Pore Pressure Integration supports multiple cores or CPUs.

Risking and uncertainty

All of MPath’s simulators are supported by MPath’s risking framework, which allows probability distributions to be wrapped around simulator inputs. Assign probability distributions to key variables, sampled using a variety of techniques, and execute multiple simulations using distributed processing. Simulation outputs are ranked according to “goodness of fit” with observed data.

Post-processing

MPath contains a rich set of tools for analyzing basin and reservoir simulations. Create time-based views, data extracts, plots, cross-plots and many more, quickly and easily.
Permedia Viewers

Permedia Viewers is a complete set of analysis and visualization tools, including a full OpenGL-accelerated 3D visualization environment, a suite of mapping analysis tools, a Well Viewer for analyzing well data, as well as powerful reporting tools for querying and analyzing data. Leveraging MPath’s industry-leading file support, Permedia Viewers allows you to co-render and analyze data from multiple packages, giving you a whole new perspective on the complex plumbing of petroleum systems. Dozens of industry standard formats are supported including SEGY, ZMap, PetroMod, Temis, Trinity, LAS, Shapefiles and many, many more.

Included with every license of MPath basin and reservoir tools, Permedia Viewers can also be licensed separately.

3D Viewer

3D Viewer can integrate regional, basin and reservoir data into a single environment. Supporting more than 100 different formats, including PetroMod, Temis, Gocad, Eclipse, Irap, 3D Viewer can be used to calibrate and add quality control to all of your models.

Map Viewer

Map Viewer is an advanced set of mapping tools that can be used for grid manipulation and preprocessing, model building, data visualization and integration. It includes all of the map analysis features required by a petroleum systems modeler, including fetch, closure and fill-spill analysis. It also features tools for basin model pre-processing, including interpolation, extrapolation, kriging and refining. Build basin models from maps and preview them cross section and in a burial history.

Well Viewer

Well Viewer includes trace colorizers, calculation options, and live links with Data Explorer for plotting well data. Take any well data as a starting point, augment it with data derived from curves, tables, volumes, and meshes, then use the combined dataset as input to calculators in user-defined scripts. Using the new equation and scripting support, create any number of traces on the fly based on existing traces, or other data added to the scene. Well Viewer supports all major well formats, drag and drop assignment of traces into tracks, interaction with other viewers, zones and markers, and more.

Well Viewer features enhanced support for a variety of data. Drag and drop any map into Well Viewer to display markers at the intersection point with the well. Drop in a seismic volume to extract values along the well path. Drop in any basin modeling mesh to extract mesh zones and properties. Drop in curves or tables to see calibration or geochemistry data plotted as traces alongside your well data.

Well Viewer also leverages MPath’s extensive data support – load data from basin modeling packages including MPath, PetroMod, Temis and Trinity; all major map and well formats; and reservoir data via Gocad objects, and Eclipse, RMS and VIP grids.
Using optional Well Toolkit extensions, add equations and custom scripts to calculate any number of traces on the fly based on existing traces, or other data added to the scene. Well Toolkit also includes DlogR as well as hooks into University of Newcastle's ShaleQuant engine.

Synchronized data views: data selected in one view is highlighted in all

Data manipulation and analysis
Permedia Viewers includes a rich set of tools for analyzing and manipulating data. Perform operations such as extracting mesh data coincident with wells, cross plotting mesh and well properties, extracting volume data along a mapped horizon, generating burial histories, querying mesh properties through time, and many, many more.

MPath's already extensive tools for manipulating data have been enhanced with flexible calculators that allow you to use equations to derive properties on virtually any data type. Use calculators in Data Explorer to dynamically plot equation-based calculations against your data. Apply calculators to well traces in Well Viewer to create new traces, and live link them with Data Explorer. Or use calculators to create new mesh properties at the basin or reservoir scale.

Platforms
Permedia MPath runs under Windows XP, Vista and 7 (32- and 64-bit), and Red Hat Enterprise Linux 4 and 5 (32- and 64-bit).

For more information
For more information, contact The Permedia Research Group:
www.permedia.ca
info@permedia.ca