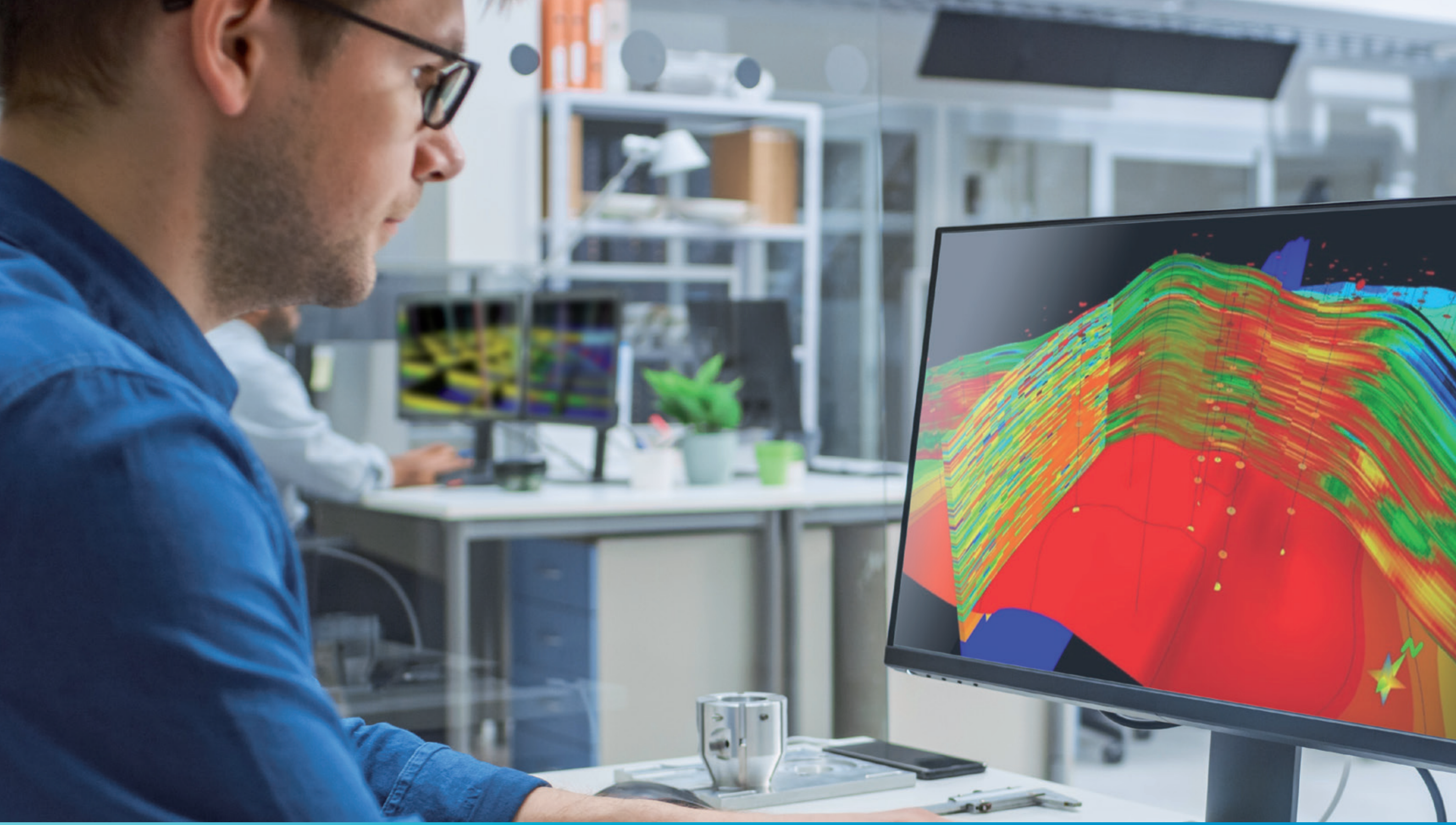

UNLOCK YOUR RESERVOIR

Integrated expertise for better informed drilling and production

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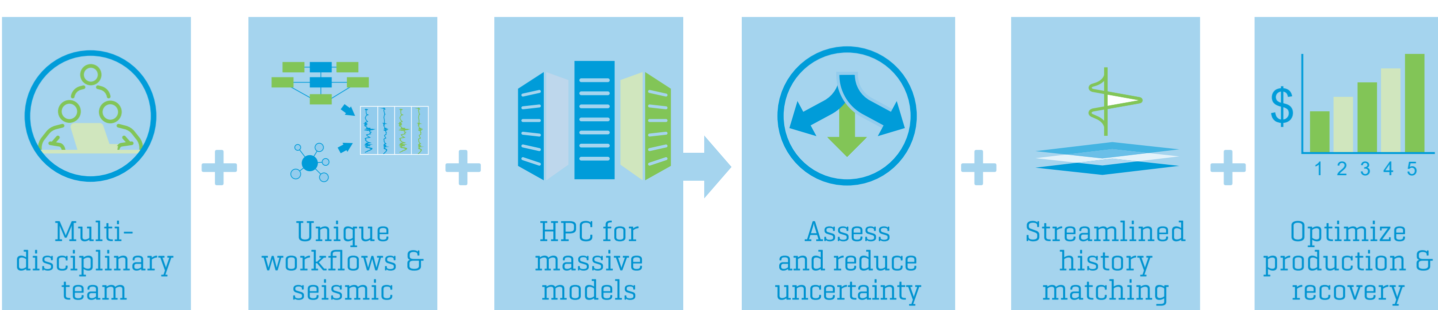
Unlock your Reservoir

Industry challenges	Reservoir consulting solutions
Evaluate uncertainty for complex reservoirs Accurate dynamic reservoir models with comprehensive strategy to quantify and reduce uncertainty.	**Strategic use of data diversity and leading seismic technology** Integrated dynamic modeling approach combining all relevant geological, geophysical and engineering data with the added-value of reliable seismic information.
Optimize field development plans Optimum well placement and design driven by reservoir quality and drilling risk reduction.	**Highly-experienced people using unique geoscience data** Multi-disciplinary team of geologists, geochemists, petrophysicists and geoscientists, with access to the global Robertson geological database and expert lab services, working in close collaboration with reservoir engineers and economists to deliver integrated reservoir studies.
Maximize economic recovery Updated field development plan with smart use of extra information refining the dynamic reservoir model.	**Advanced reservoir modeling and monitoring** Efficient production-focused reservoir workflows using proprietary seismic reservoir characterization technology to capture additional information, featuring: • Fracture characterization / Geomechanics for EOR optimization • Smart update of static models using recent seismic data • Preservation of geological information during history matching

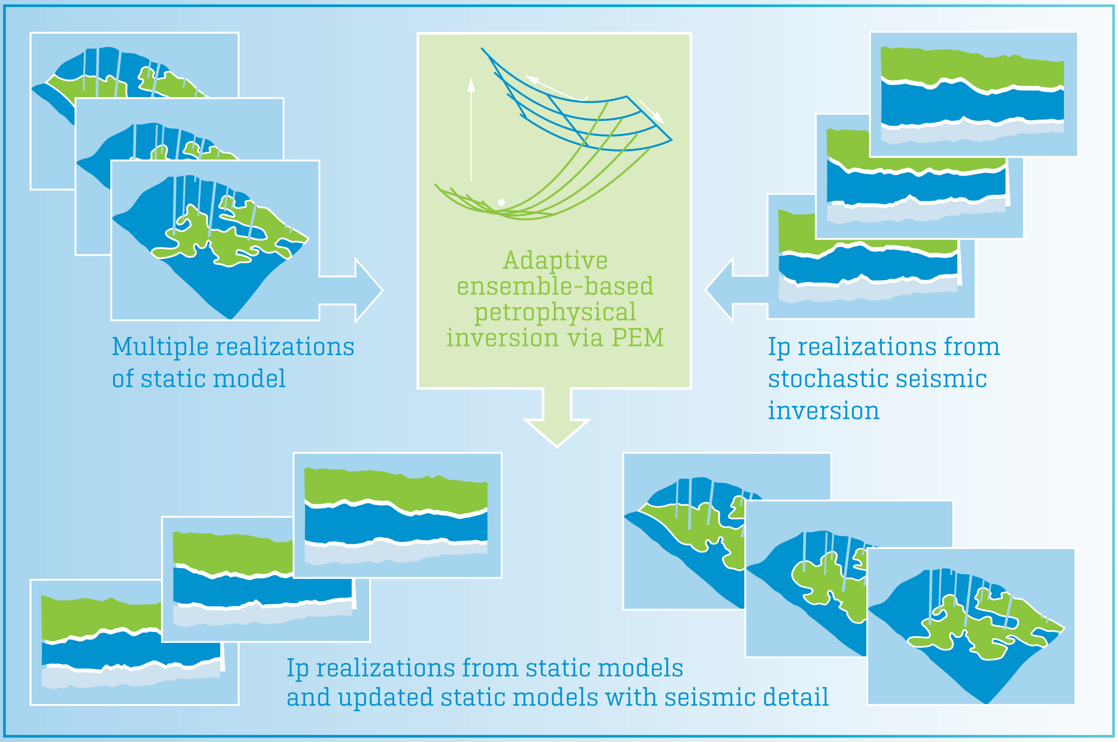


Unlock your Reservoir

Advanced Reservoir Characterization

Achieve more detailed and accurate static models for complex reservoirs with our advanced reservoir characterization workflows built on innovative technologies:

- Full petrophysical analysis and rock typing
- Comprehensive clastic, carbonate and fractured reservoir characterization
- Proprietary adaptive ensemble-based petrophysical inversion
- Facies analysis, flow unit description, visualization and reservoir modeling



Our adaptive ensemble-based petrophysical inversion (Moyen et al., 2019) reconciles static models with the seismic inversion results through a petro-elastic model (PEM), addressing the long-standing challenge faced by geologists and geophysicists. It can be applied using a deterministic or stochastic approach.

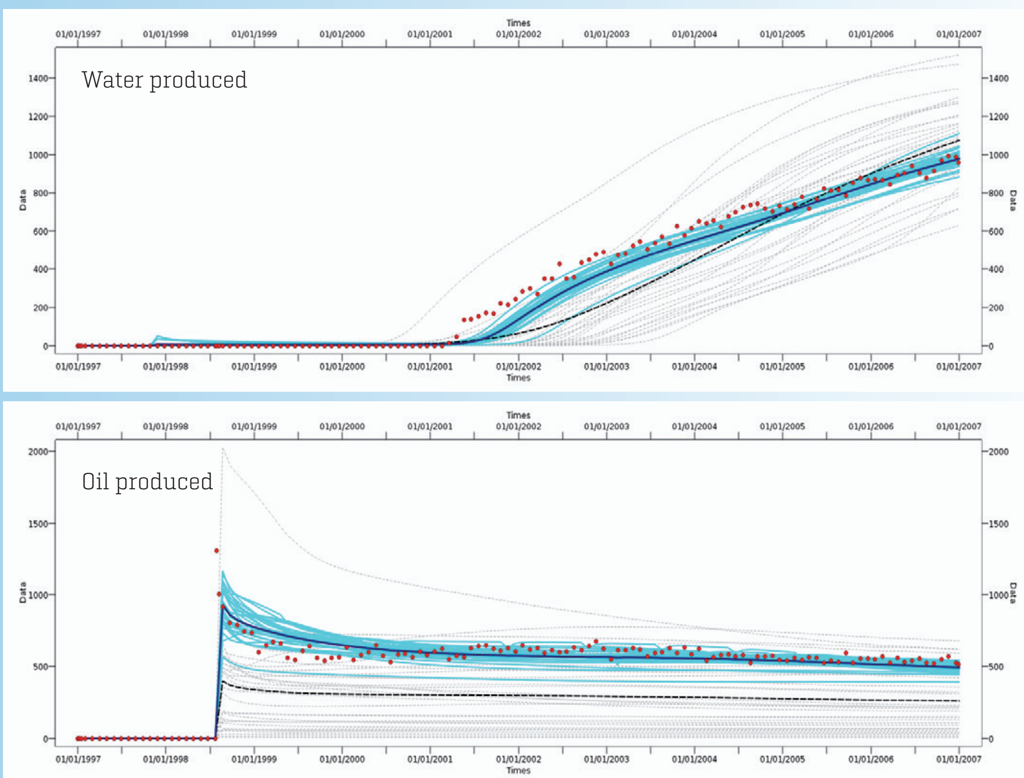
- An ensemble of a priori models populated with petrophysical properties is generated using the available geological and well data and stochastic methods
- The seismic elastic inversion models are generated by our stochastic inversion engine
- The adaptive ensemble-based petrophysical inversion updates the static models using a nonlinear PEM constrained by the seismic inversions
- An ensemble of optimized and realistic seismically-constrained geomodels are generated for better flow simulation and history matching, whilst providing understanding of uncertainty in the results

Unlock your Reservoir

Reservoir Modeling

Understand uncertainty in your reservoir models and flow simulations, and streamline history matching with our stochastic modeling workflows:

- Optimized static reservoir modeling
- Proprietary multi-scale ensemble-based history matching
- Equation-of-state modeling



Using ensemble-based history matching, multiple realizations of static reservoir grid properties (permeability, porosity, etc.) are updated in order to improve the match to the observed production history data (red dots). The grey curves show flow simulation results of the realizations before and the blue curves show the results after ensemble-based history matching of these multiple realizations of static properties.

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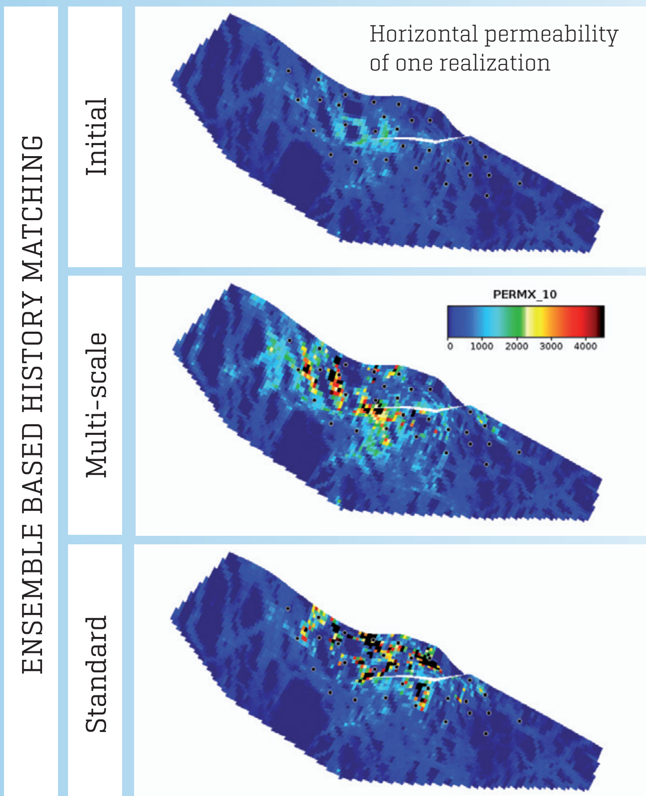


Multi-scale ensemble-based history matching provides more accurate static models by preserving information from the seismic and geological features (such as channels) and helps to avoid unrealistic updates associated with the standard approach.

Multi-scale ensemble-based history matching (Gentilhomme et al., 2015) aims to improve the match of observed production data with simulations from static models which better preserve the structure within the initial models that may carry important information such as seismic or geological interpretations:

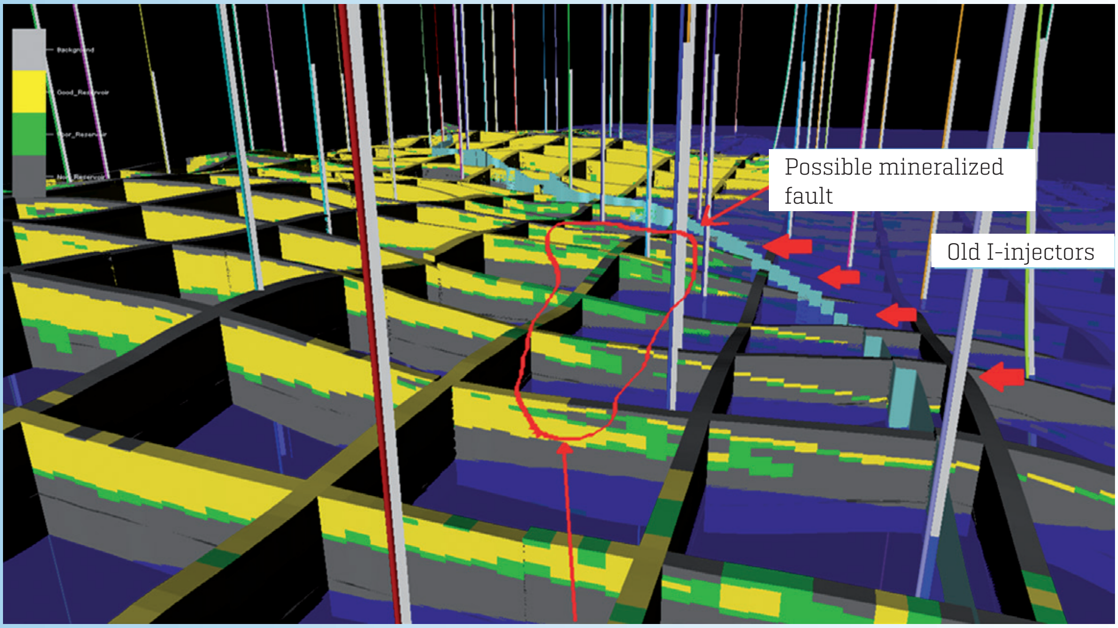
- Flow simulations conducted for the entire ensemble of static model realizations - production responses are compared with production observations
- Inversion of the static models to better fit the production observations
- Multi-scale approach (starting with a coarse grid and progressing to finer grids) to ensure a better overall dynamic model history match which still preserves the structural details from the seismic data in the static model
- Multi-scale ensemble-based history matching can be applied on seismically-constrained static and dynamic models
- Seismic information is preserved throughout the process from static modelling to dynamic modelling; uncertainty is assessed and reduced during history matching

Unlock your Reservoir

Reservoir engineering and field development

Mitigate risk and improve field development plans by leveraging our combined geoscience and engineering expertise:

- Reservoir performance predictions and field development planning
- Integrated field development optimization and economics
- Engineering workflows for material balance, well pressure test analysis and nodal analysis
- Geomechanical studies



A recent study addressed the challenges of failed injectors in a field development project:

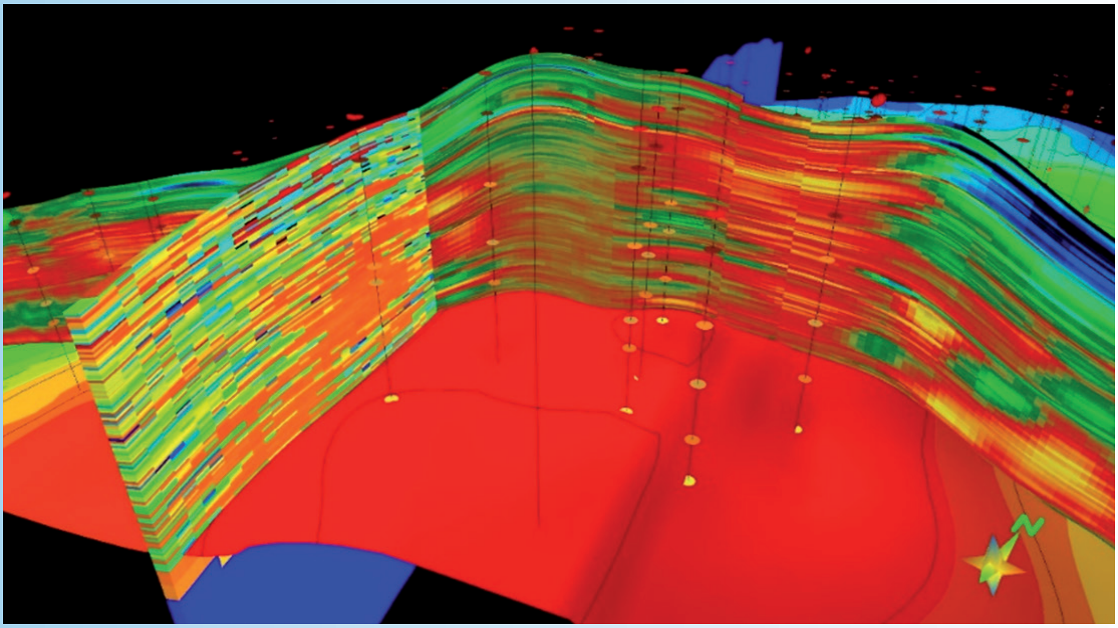
- Seismic inversion delineated the margin of the good reservoir quality facies based on lithology, porosity and connectivity and helped to identify flow barrier faults (blue vertical surface)
- Analysis of the failed injectors revealed they were on the flanks of the field within low-porosity facies with poor connectivity
- New, effective injector locations (red outline) were identified from the study

Unlock your Reservoir

Production optimization

Make better reservoir management and economic decisions based on more accurate dynamic models. Our integrated workflows put all your data to work to generate better models which reduce uncertainty:

- Dynamic model updates for primary and enhanced recovery
- Volumetric determination, assessments, risking and probabilities
- Reserves and resource estimation
- Equity determination and re-determination



In this project we helped a client improve their recovery factor by taking a truly multi-disciplinary approach to update the reservoir model and integrate 4D seismic information:

- All geological data integrated into the static model
- Static model update using our proprietary adaptive ensemble-based petrophysical inversion
- Dynamic simulations were used to predict the 4D seismic effect of production to aid interpretation and update field development plans

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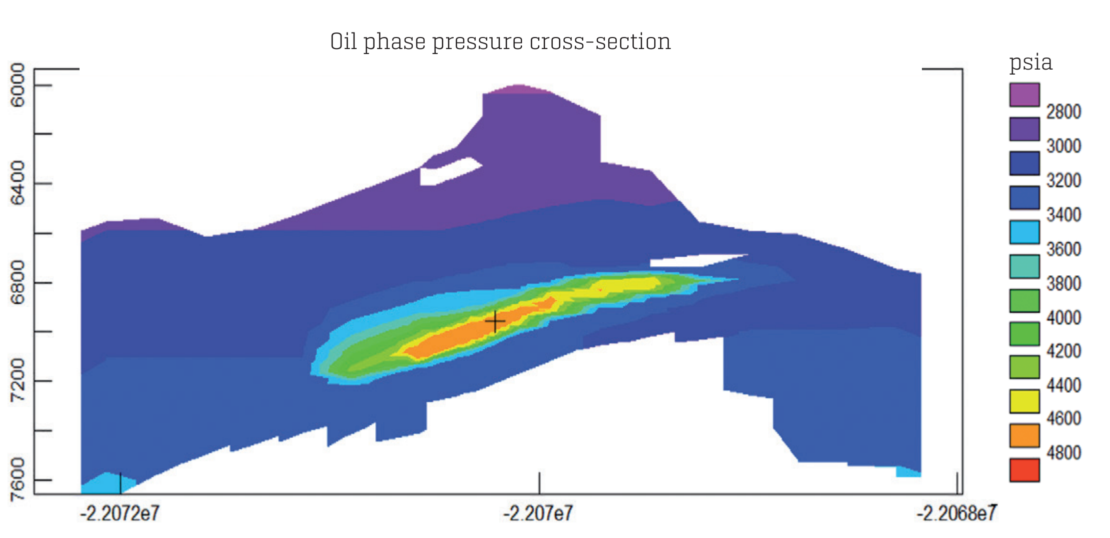
Geomechanics

Get greater insight into the important role of geomechanical effects across the development and production cycle with coupled reservoir and geomechanical modeling and simulation using GeoSim®. Our experts have experience across a range of challenges and complex production scenarios:

- Wellbore and casing integrity
- 1D and 3D Pore Pressure Prediction (PPP) and Mechanical Earth Model (MEM)
- Full field compaction
- Waterflood and waste injection
- Fault reactivation
- Conventional and thermal fracturing
- Shale play and tight formation well completion, stimulation and interference
- Tar sand heavy oil surface heave, caprock integrity and MOP
- Sand production and wormhole growth modeling



Coupled reservoir and geomechanics modeling services were used to optimize secondary recovery in a North Sea fractured sandstone reservoir. The mechanisms and geomechanical effects controlling injectivity, damage and dynamic fracturing were identified, including thermal effects and injection water quality. This provided the operator with optimal injector well completion/performance while safely maintaining fracture containment and flood management in the reservoir.

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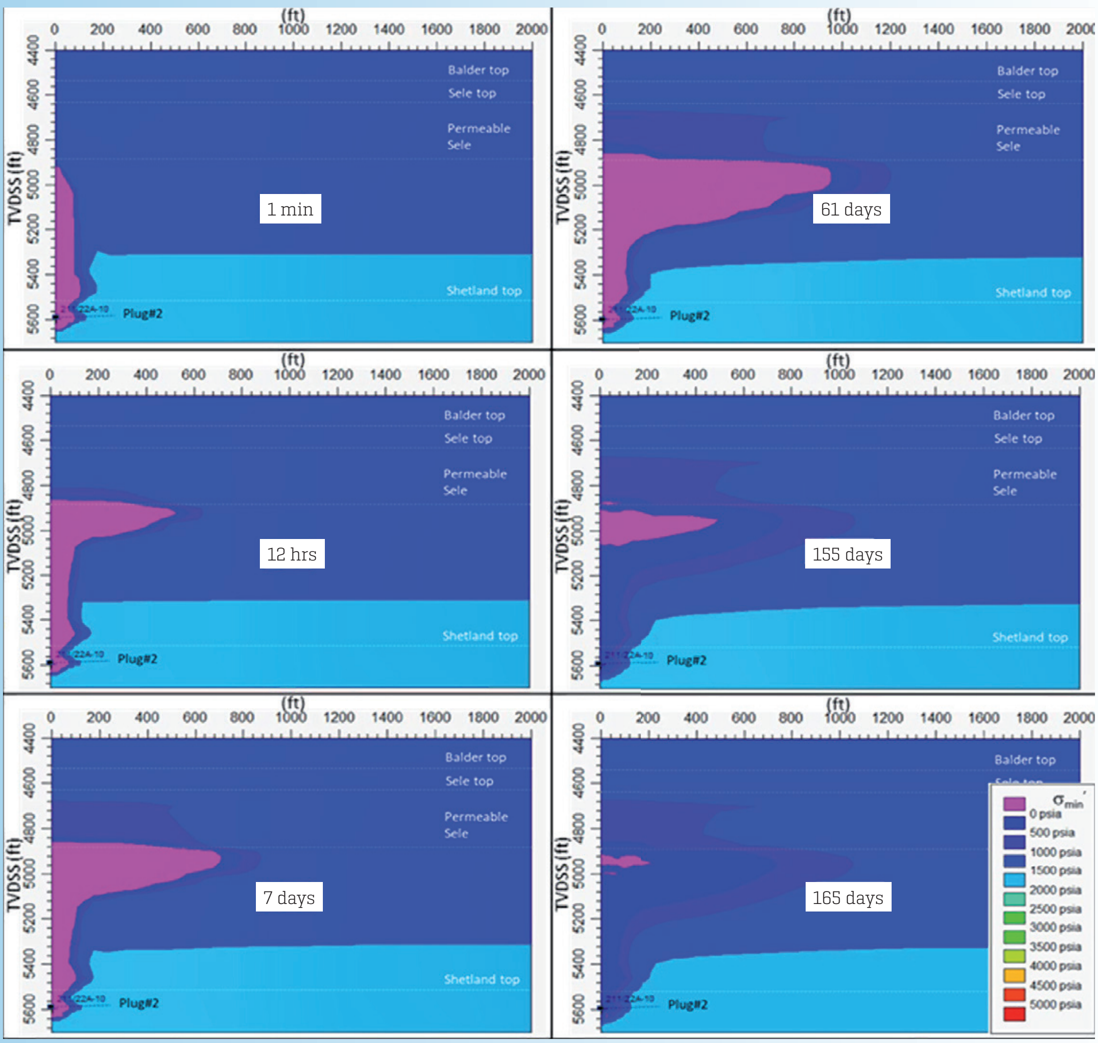

Dynamic fracture growth for an abandoned well in the North Sea was modeled with a coupled simulation using a highly non-linear Barton-Bandis dynamic fracture model. Risk analysis was performed for an incorrectly positioned secondary plug (at shallower depth) in case the first plug (at deeper depth) failed. The conclusion based on the coupled modeling was that fracture vertical growth would be contained by the permeable Sele Formation and overpressured reservoir fluid would transfer to the Sele until the induced fracture closure.

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