EBPetro

Ensemble-based petrophysical inversion

CGG

INDUSTRY CHALLENGES

Integrity

Introduce additional geological detail into the static model using the information embedded in seismic inversion volumes using petro-elastic controls.

Uncertainty

Assess uncertainty by exploring the full range of possible rock physics-constrained realizations with ensemble-based optimization of stochastic models.

Efficiency

Create and update many static model realizations quickly and reliably to streamline flow simulation and history matching.

GEOSCIENCE SOLUTIONS

EBPetro ADVANTAGES

- More accurate and geologically-consistent seismic-driven static models will improve reservoir assessment and field development planning

- More reliable models will reduce the need for arbitrary and unrealistic dynamic model modifications to achieve a history match

- Provides an understanding of the full range of possible reservoir models and helps to quantify uncertainty of net pay, connectivity and production
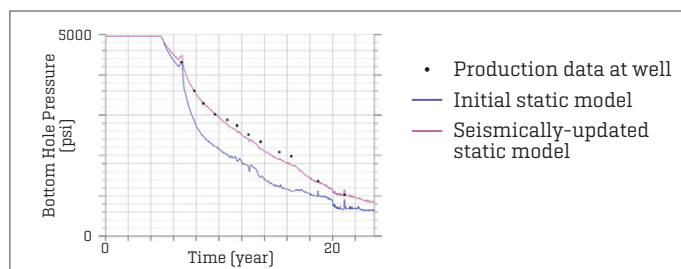

Porosity
15 – 25%
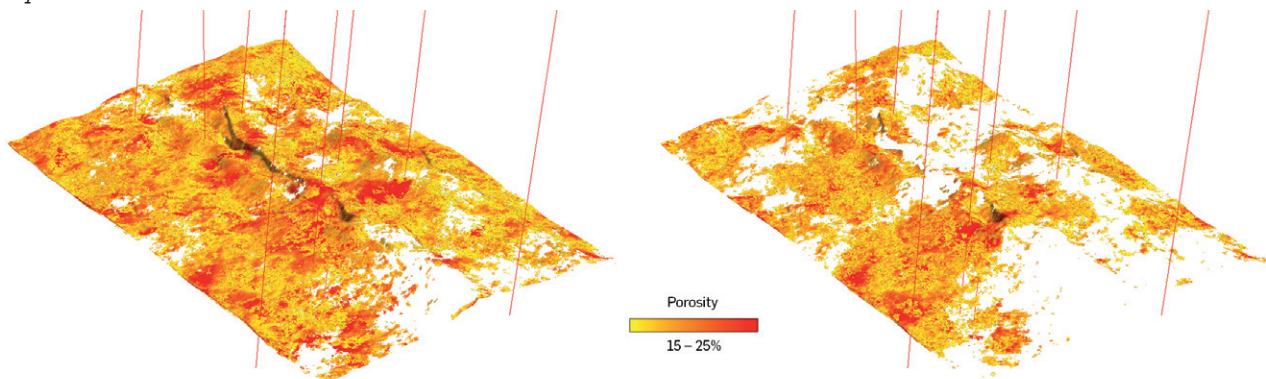
Increasing the influence of the seismic elastic properties in the petrophysical inversion adds geological detail in the static model properties away from the wells.
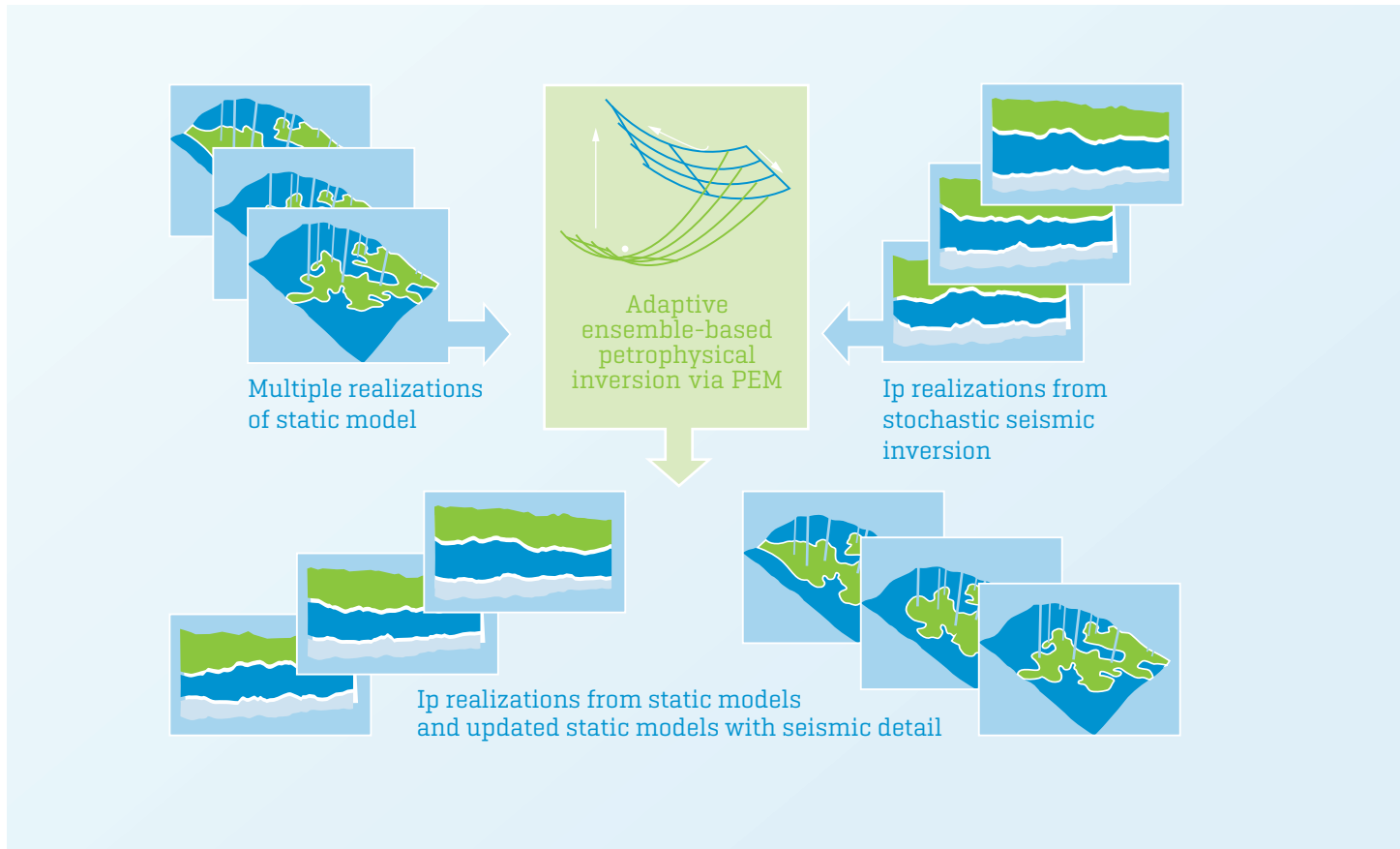
Left: standard static model modeling result with low seismic influence favours well information.

Right: stronger seismic influence brings more accuracy to the inter-well volume and results in better predictions of production, even before history matching.

From Moyen et al., 2019.

- Production data at well
- Initial static model
- Seismically-updated static model

EBPetro WORKFLOW

Multiple realizations of static model

Adaptive ensemble-based petrophysical inversion via PEM

Ip realizations from stochastic seismic inversion

Ip realizations from static models and updated static models with seismic detail

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