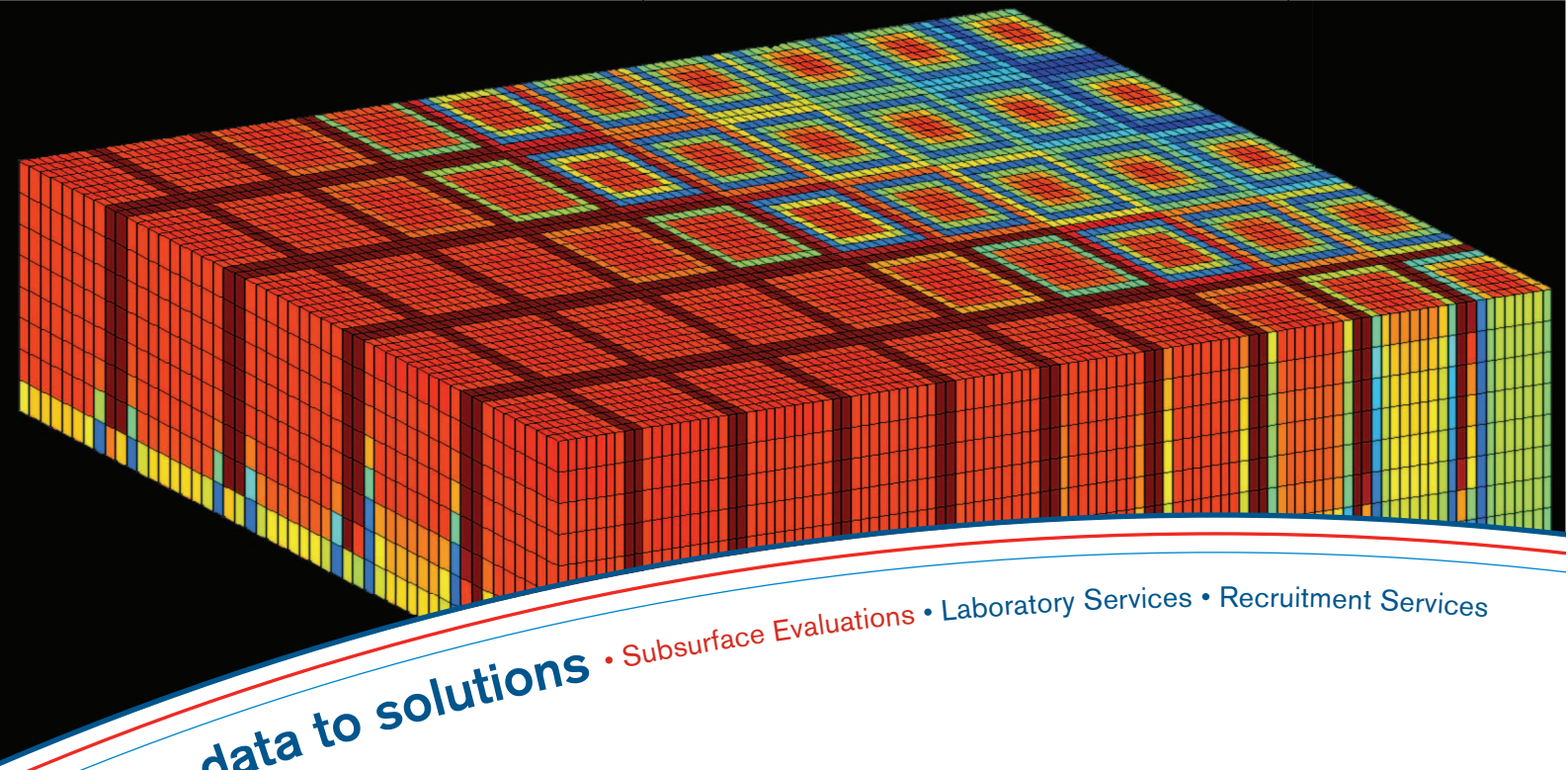


From data to solutions • Subsurface Evaluations • Laboratory Services • Recruitment Services

Enhanced Oil Recovery

EOR methods:

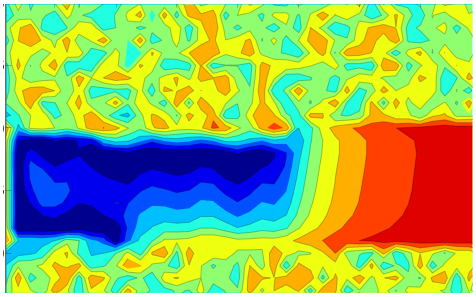
- Gas EOR
- Water-based EOR
- Thermal EOR
- Combined EOR

The Theory

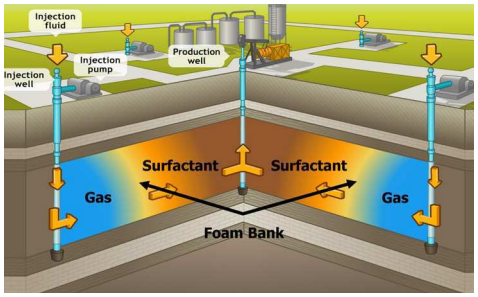
Tertiary or enhanced oil recovery (EOR) is oil recovery by injecting materials not normally present in the reservoir. EOR techniques are employed to improve both the sweep and displacement efficiencies. These techniques alter fluid and/or rock-fluid interaction properties. Some of them (e.g., thermal recovery, miscible gas injection) mainly modify the oil properties. Polymers increase water viscosity, while surfactants lower the interfacial tension between oil and water and reduce residual oil saturation. In foam flooding, a mixture of surfactant, water, and gas can turn into foam and gas-phase mobility is reduced by making a stable foam.

The three major categories for EOR methods are gas EOR, water-based EOR, and thermal EOR. Each of these methods performs at its best if it is applied at the reservoir conditions that are favourable for that method. These conditions involve the oil and water saturation at the start of the tertiary recovery, oil properties (composition, API gravity, and viscosity), reservoir temperature, pressure, thickness, depth, porosity, permeability, reservoir type, and rock type.

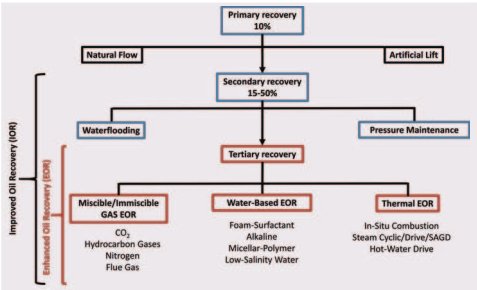
EOR techniques are relatively expensive; hence, it is extremely important to optimize them to have an economically feasible process. Validation by experiments is often considered an essential step before testing the EOR approaches in the field.



Porosity Distribution (Salimi, 2010)



Surfactant-alternating gas (SAG). Adapted from (www.snfoil.com)



Oil Recovery Methods (modified from Moritis, 2000)

PANterra GEOCONSULTANTS

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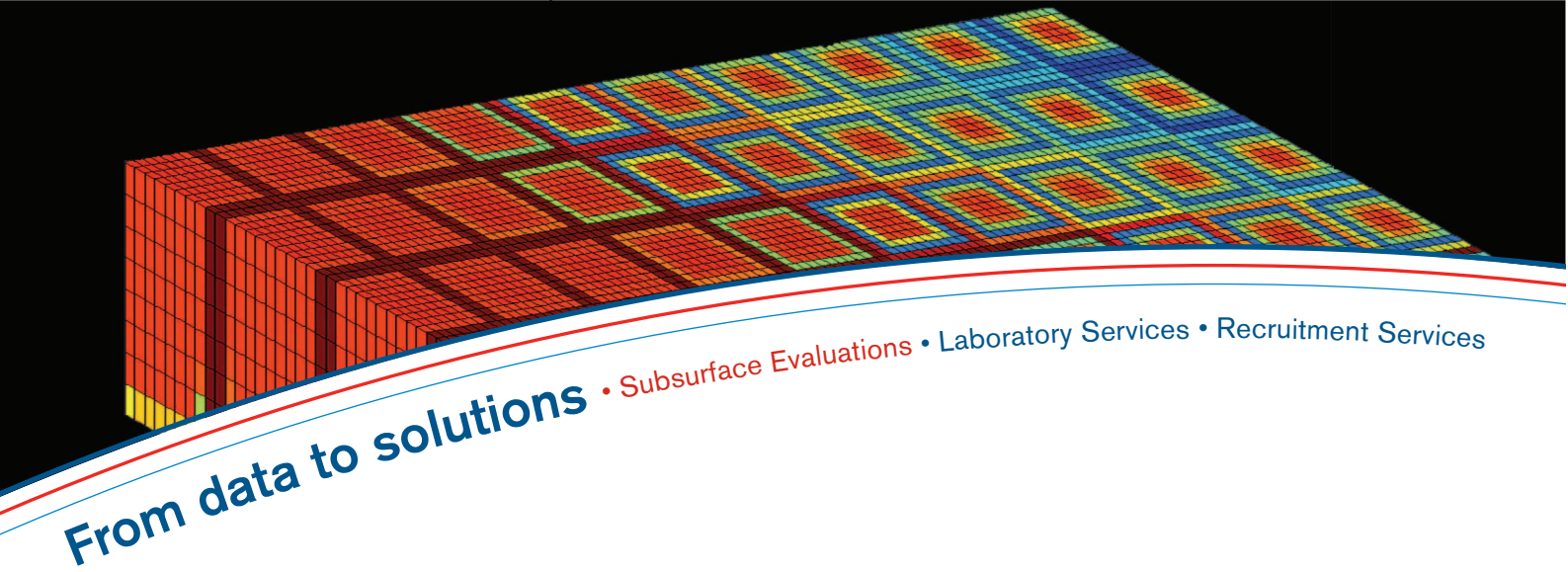


Enhanced Oil Recovery

Services we provide:

- Quick EOR screening
- Analytical modeling
- 3D detailed static reservoir modelling
- 3D detailed dynamic reservoir modelling
- Optimization
- Economic evaluation
- EOR project management

The Practice – All you need to know fully integrated under one roof

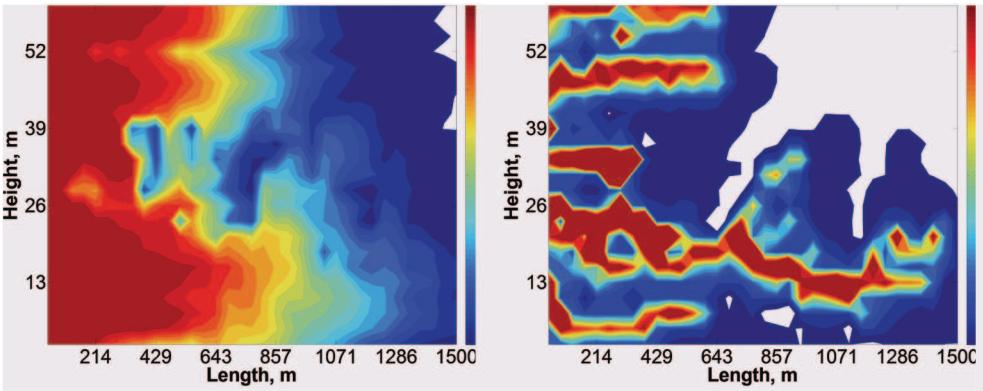
PanTerra Geoconsultants BV realizes the challenges of today hydrocarbon concern, i.e., maximizing the economic potential and minimizing the risk of these rather expensive EOR projects failing in the execution phase.

Having a well-equipped laboratory for rock/fluid interaction, PVT, and core flooding for EOR methods in addition to EOR-specialist reservoir-simulation engineers makes PanTerra a unique place to carry EOR projects. PanTerra's laboratory equipment is fully the state-of-the art and developed in close contact with Universities in Great Britain and the Netherlands.

Building on our expert knowledge in EOR-subsurface modeling and reservoir characterization in combination with our well established laboratory service for EOR, PanTerra is capable to provide comprehensive EOR services ranging from quick EOR screening, analytical models, 3D detailed static and dynamic reservoir models, optimization, economic evaluation, and EOR-project management. By integrating wireline, seismic, and core data, quantitative static models can be generated that serve as input for dynamic reservoir models. With the support of our SCAL, PVT, and EOR core-flooding experts these models are loaded with appropriately selected capillary pressure, relative permeability, PVT, and compatibility datasets.

Our EOR specialist reservoir-simulation engineers, familiar with most industry standard simulation packages, build dynamic reservoir models, tailor-made to the Client's project objectives. Models may range from 1D analytical models for quick EOR screening to detailed 3D reservoir models for full-field development studies. Given our experience in field development planning, realistic development scenarios are generated. On request, screening economics can be performed to select economically viable projects.

In summary, based on our expert knowledge in EOR modeling and reservoir characterization and our proven record in performing experiments, PanTerra can integrate your available subsurface data to determine the optimal EOR plan. This optimal includes not only the subsurface part, but also economics, environment, as well as surface facilities.



CO_2-concentration distribution after miscible /immiscible CO_2 injection (Salimi et al. 2012)

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