The Effect of Fractures for a Middle East Oil Reservoir

Single or Dual Porosity Formulation for Reservoir Simulation?

Vidar Haugse, Steve Ogilvie, Statoil ASA

Contact information: Address: Arkitekt Ebbellsvei 10, Rotvoll, N-7005 Trondheim, Norway, Phone:+47 73584011, Fax:+47 73967286, E-mail: Vidar.Haugse@statoil.com, Steven.Ogilvie@statoil.com

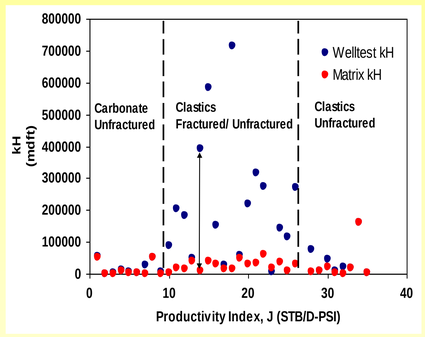
Abstract: The effect of fractures were evaluated for a moderately fractured oil reservoir in the Middle East. All static and dynamic data sources were used in a fracture characterization study for this mixed clastic (70 %) / carbonate (30 %) reservoir, where discrete fracture network (DFN) modelling was used to generate fracture properties for reservoir simulation models.

A single porosity full-field model was successfully history matched, providing a good match to 40 years of production by strong aquifer support. A dual porosity model was set up based on the fracture characterization study and the single porosity model, but too much oil was trapped by capillary pressure in the dual porosity model. Carbonates are more fractured than clastics for this reservoir, and a hybrid reservoir simulation model with a single porosity formulation for layers with mainly sand and a dual porosity formulation for layers with mainly carbonates was therefore evaluated. A succesful history match was also obtained with the hybrid model.

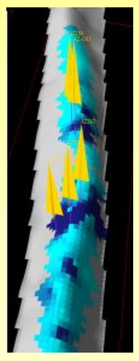
Fracture Modelling

Fracture Drivers

Main data sources for the fracture characterization study

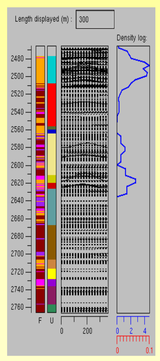


Excess permeability



Mudlosses

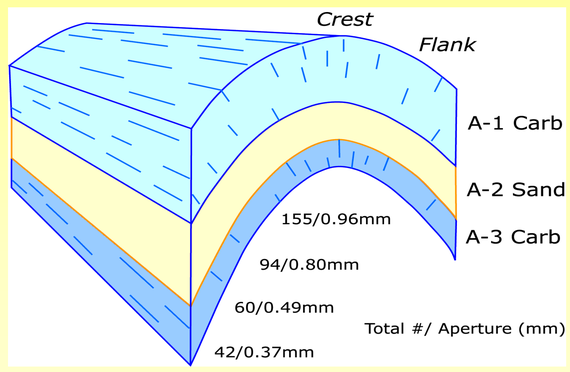
Cores



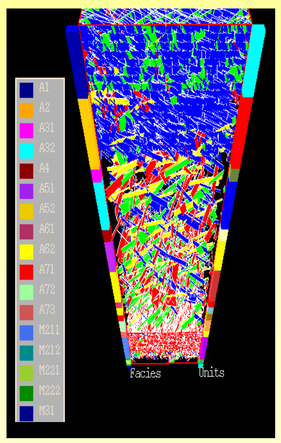
Borehole image analysis

Conceptual Model

Carbonates are more fractured than clastics for this reservoir



Discrete Fracture Network Modelling

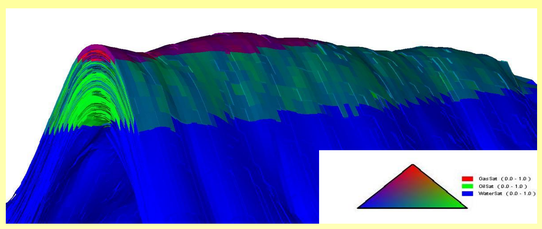


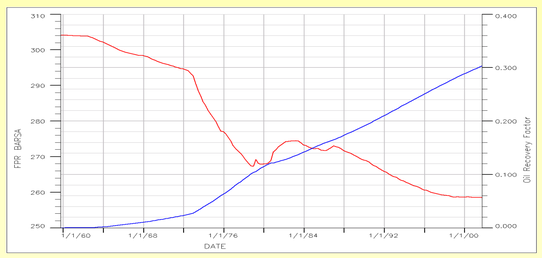
Modelling approach

- All sources of input data are used by discrete network model
- Stochastic approach is used to generate realisations of fracture network
- Upscaled fracture properties are generated for reservoir engineering studies
  - Permeability
  - Porosity
  - Stack height

Reservoir Simulation

Single Porosity Model

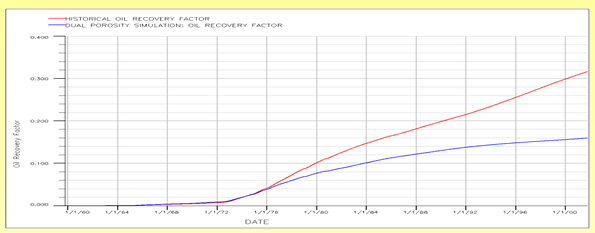


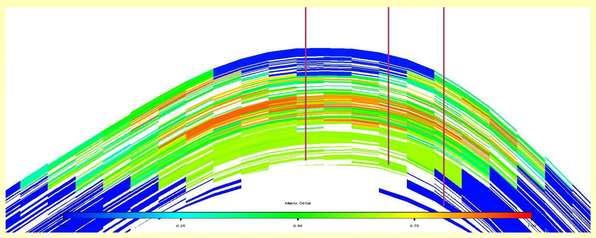


Successful history match with single porosity model

Dual Porosity Sector Model

Based on the fracture characterization study and the single porosity model

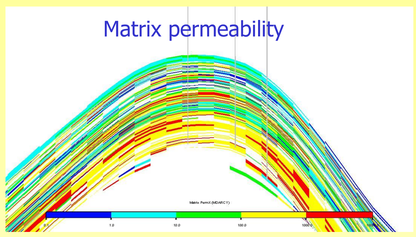


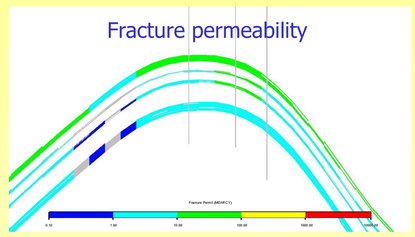


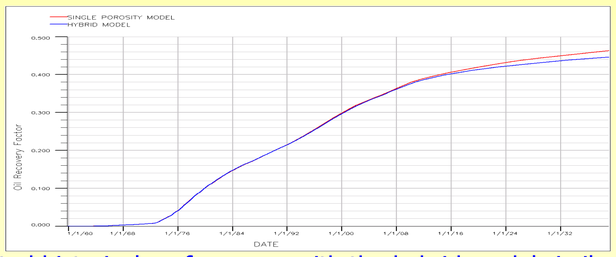
Simulated oil production is too low because oil is trapped by capillary pressure in dual porostity model

Hybrid Sector Model

Single porosity for sand layers, dual porosity for carbonate layers







Simulated historical performance with the hybrid model similar to the single porosity model, but predictions may differ

Conclusions: **Fractures are most likely not connected in the majority of the reservoir, and using a single porosity formulation in the full-field model is therefore reasonable. However, a good history match can also be obtained with a hybrid formulation and this may influence predicted performance of new drainage strategies.**