

Extended Structural Modelling Workflow for Better Reservoir Modelling

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3D reservoir modelling in the oil and gas industry represents construction of a numerical model for petroleum reservoirs by an assemble of discrete grid cells. This is the essential workflow in order to improve the confidence of the reserve size and as a guide for making decisions for the field development, such as predicting future production, placing additional wells, and evaluating alternative reservoir management scenarios. Reservoir models typically fall into two categories that are (1) geological models aim to provide a static description of the reservoir, prior to production and (2) reservoir simulation models use finite difference methods to simulate the flow of fluids within the reservoir, over its production lifetime.

Structural modelling is the first process of the geological model using available seismic and well data. It conventionally delivers the conceptual & physical structural framework, and by visualized geometrical features consistent with regional/local tectonics. Main products are the bulk rock volume as the most influential parameter of reserve calculation, and an assemble of discrete grid cells with fault, formation surface & depth and their spatial relationship for the following property modelling.

This presentation talks how to apply theoretical ideas to the practical structural modelling. Field A in Abu Dhabi, U.A.E. has multi carbonate reservoirs in the positive flower structure by regional strike-slip fault tectonics. The structural concept of the initial reservoir model is the anticlines is surrounded by 2 continuous closed strike-slip faults interpreted from the old 3D seismic and only 2 wells' data. However, as increased additional well data and acquired new 3D seismic volumes, various scenarios of structural models are proposed and updated. Moreover, the powerful computing capacity and numerical algorithm enable structural modelling to refine more complex reservoir structure more frequently. Subsurface morphology and major concept of fault style changed. Additional dataset for free water level and new seismic attributes analysis doesn't support N75W boundary faults are closed and N30W faults present. The paleo-structure evolution is built based on the seismic surface flattening.

In addition to the macro-scale structural model update, the continuous studies realize the meso- to micro-scale of deformation analysis workflow controlling reservoir properties. Few metric-scale of correlated deformation stratigraphy is used as specific layer for the purpose of the vertical compartment. The micro-fractures observed by micron scale high resolution of CT scan image from the full diameter core are used to manipulate reservoir permeability. Dynamic well test data identified the locally enhanced permeability zone around fault.

The advanced workflows undertaken aided in improving structural complexity and reservoir properties. However, remaining uncertainties in the current reservoir models still need more studies. The continuous effort to improve models is required during the upcoming production and appraisal period.