Constraining 3-D Modeling of Structure, Porosity and Permeability Using a Combination of Geology-Controlled Deterministic and Stochastic Techniques to Minimize Uncertainty: Example from a Giant Carbonate Reservoir, Onshore Abu Dhabi, United Arab Emirates

Luis Ramos[1]*, Shamsa Al-Maskary*[1]*, Gerard Bloch*[2]*, and Avni Kaya*[3]*. (1) UFR Team, ADCO, Abu Dhabi Company for Onshore Oil Operations, P.O. Box 270, Abu Dhabi, United Arab Emirates, phone: +971504140995, fax: +97126667276, lramos@adco.ae, (2) Planning & Quality Department (PQD) / Petroleum Dev. Division, Abu Dhabi Company for Onshore Oil Operations (ADCO), PO Box 270, Abu Dhabi, United Arab Emirates, (3) Kelkar & Associates, Inc, 3528 East 104th Street, Tulsa, OK 74137*

Applied to a giant undeveloped carbonate reservoir located onshore Abu Dhabi, a comprehensive and effective workflow using stronger geological controls on 3D modeling of structure, porosity and permeability is described.

Depth grids are constructed using 3D seismic and isochores. Geology honoring positive or negative depth trends are used respectively for porous and dense intervals isochores.

Porosity modeling starts, at well locations with overburden correction of core porosity followed by a linear correction of log porosity controlled by the former. To honor the core porosity and account for the uncertainty of measurements, a stochastic technique using the residuals between core and log corrected porosity was developed. Then 3D porosity models are created through stochastic modeling using porosity versus depth trends and a base case is selected.

Permeability modeling uses a mixed deterministic/stochastic technique. Missing permeability intervals from wells with production tests are edited using porosity versus permeability plots and Kh derived from test results or dynamic history matching, minimizing the multipliers need. Geology based power lines fitted to porosity versus permeability clouds are then used to convert the base case porosity model into a 3D synthetic permeability model lacking the well data variability. This is re-incorporated through stochastic simulations of the residuals between the synthetic and real well values and a base case permeability model is selected. Finally, a permeability multiplier volume is generated to match test results. Uncertainty is accessed through creation of high and low cases.

Produced static models were successfully used in dynamic simulations with very limited adjustments.