

Stochastic Inversion: A Case Study

Bertrand Six¹

¹CGG GeoConsulting

ABSTRACT

Building a reservoir model by integrating seismic angle stack and well data has been a challenging study for oil and gas companies. The seismic data contains very useful information of reservoir properties laterally but lack vertical resolution while well data provides very detailed information vertically but a lack of horizontal information. One method of integrating these two data is through deterministic seismic inversion. Deterministic inversion has been proven as a good method in delineating the reservoirs at the seismic resolution but faces problem in analyzing thin reservoir. Geostatistical inversion methods integrate a broader range of data to produce multiple, plausible realizations of reservoir models at reservoir rock scale allowing the capture of thin reservoirs & features.

An AVA Geostatistical seismic inversion workflow was successfully implemented to produce highly detailed reservoir models of Abu Madi reservoir sands in the Egyptian delta. Abu Madi Formation is composed of lacustrine turbidite deposits in a semi isolated basin and can be subdivided into upper and lower sandstones. The intraformational shale barriers and baffles are also commonplace within Abu Madi Formation. Well data analysis has demonstrated the complex pattern of the stacked reservoir sand zones of heterogeneous reservoir parameters and pressure trends. The main objective of the study was to produce reservoir models that could be used to understand the observed pressure depletion trends within the Upper and Lower Abu Madi reservoirs which have great importance for effective field management.

Integrating seismic angle stack and well data through geostatistical AVA inversion to produce 0.5ms vertical sampling, highly detailed lithotypes and elastic model results; were able to capture the shale baffles which acted as barrier to the pressure depletion of the Abu Madi Upper and Lower reservoirs. Lithotype and elastic property realizations were cosimulated and ranked P10, P50 and P90 of effective porosity and volume of clay. Five permeability rock types were derived based on extensive SCAL database into permeability and saturation models. These detailed reservoir models were used for dynamic flow simulation and successfully predicted the pressure depletion trends in Abu Madi reservoirs.