INTEGRATION OF 3D SEISMIC ATTRIBUTES INTO STOCHASTIC RESERVOIR MODELS USING ITERATIVE VERTICAL RESOLUTION MODELING METHODOLOGY

Jianwei Wang and Qifeng Dou
Schlumberger, Long Beach, CA 90802, ershaghi@usc.edu

At early stages of field development, there is generally no sufficient well data available to predict reasonable reservoir property distributions. Integrating densely distributed seismic attributes as a secondary constraint can significantly improve the accuracy of reservoir models and reduce uncertainties. However, one challenging problem facing is scale difference between seismic and well log. Geostatistical modelers encounter both upscale and down-scale issues. We illustrate an iterative vertical resolution modeling methodology to compromise both seismic and log resolutions, and a new geostatistical modeling technique for generating better reservoir models. Vertical variogram analyses on log data were conducted to determine an upper-limit vertical resolution for each geological zone. Under this vertical resolution, the heterogeneity of log properties can be preserved. Different 3D reservoir models with different scales were built. Log porosities were upscaled and seismic acoustic impedances were sampled (down-scaled) into these models. A correlation coefficient between log porosity and acoustic impedance for each zone in each model was calculated. Within the upper limit of the log resolution, the best vertical scale that compromises both log and seismic scales was decided based on the best correlation. Horizontal variogram analysis was then conducted based on densely sampled correlated acoustic impedances. This method overcame the common difficulty in conducting horizontal variogram analysis using aerially sparse log data and provided a better quantitative estimate of spatial correlation. Sequential Gaussian Simulation coupled with Collocated Co-kriging was then used to populate porosity. The methodology was applied to the Gullfaks field in North Sea. The workflow described yielded a reservoir model much improved over conventional stochastic modeling methods and greatly reduced uncertainties on porosity distribution away from wells. The chief technical contribution is the presentation of an iterative vertical resolution modeling methodology that compromises both seismic and log resolutions to integrate seismic into reservoir model.