

De-Gennaro, S., Grandi, A., Escobar, I., Deplante, C., Onaisi, A., Irving, A. & Obi, E. 2007. Integrating Geosciences and Engineering Disciplines for Reservoir Characterization. SEG/AAPG/SPE Data Fusion Workshop, 14-18 October, Vancouver, Canada.

ABSTRACT

In recent years, the quest for better predictability of reservoir behaviour has led to the need to construct more complex and realistic models, where reservoir engineering and geosciences disciplines interact. Time-lapse (4D) seismic has been applied in both quantitative and qualitative manner to better understand and predict the dynamic behaviour of reservoirs. For stress sensitive geological systems, hydrocarbon production induces changes in the effective stress field within and around the reservoir, which result in expected effects, including changes in seismic velocities and layer thickness. Reservoir characterization and monitoring will therefore require the integration of flow, geology, geomechanics and time-lapse seismic.

In this study, we have developed an integrated workflow that combines results from 4D seismic inversion, reservoir simulation and geomechanical modelling in a shared earth model. It has been applied to a high pressure, high temperature field located in the North Sea. This is a structurally complex field which poses a big challenge for a shared earth model approach. The 4D seismic have been inverted into interval time-shifts with a maximum estimated value of 5 ms (about 1 sample). In parallel, a coupled reservoir-geomechanical model has been constructed from seismic, dynamic and geological information. The interval time-shifts from the seismic inversion are then used to fine tune this coupled model in order to preserve the consistency with the 4D seismic response.

Assuming vertical ray paths, we used a direct relationship between timeshifts and vertical strain. This is characterised by a dimensionless parameter, R , which represents the ratio of timeshifts that result from changes in velocity to timeshifts resulting from displacements. The fine tuning procedure referred to above involves the estimation of values for R that, when applied to the geomechanical model, will reproduce the observed seismic timeshifts response.