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Use of Seismic Inversion in the Integrated 3D Modelling of a Giant Carbonate Reservoir: Mauddud Limestone, Sabiriyah Field, North Kuwait

The Mauddud Limestone forms a giant oil reservoir in the Sabiriyah field of North Kuwait. Full-field static and dynamic models are being used to characterize the reservoir and predict future performance under water flood.

A full-field 3D seismic volume was deterministically inverted to acoustic impedance and transformed to porosity. The seismic porosity was used to guide a geostatistical well based effective porosity distribution and parts of a multi-component effective horizontal permeability distribution.

Effective horizontal permeability is composed of matrix permeability, permeability associated with secondary porosity and fracture permeability. Matrix permeability is largely related to primary effective porosity. Permeabilty associated with secondary porosity mainly takes the form of vuggy grainstone bodies. Fracture permeability is largely lithologically controlled. Low porosity, brittle cemented zones adjacent to more ductile and porous zones tend to fracture preferentially. Vuggy and fracture prone areas were predicted in logs and distributed vertically to correspond with flow profiles observed in PLT logs. The magnitude of the permeability assignment was calibrated by comparison to well tests.

The geostatistical object modelling of vuggy grainstone belts within the 3D static models was guided by high seismic porosity trends. Appropriate ranges of lateral continuity of low porosity fracture-prone intervals away from wells were derived by correlation to contrasts in zonal average seismic porosity.

The effective directional permeability has been incorporated into both a full-field streamline and compositional simulation model. These are currently being history matched and will be used to guide future field development.