Determining Reservoir Compartmentalization Using Differential Wide Aperture Seismic

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Knowledge of the geometry, compartmentalization, and interconnection of zones within a production reservoir is vital for the efficient management of the hydrocarbon asset, and the planning to maximize recovery. General geometric constraints of the field may be obtained from the normal reflection seismic technique; however, the detailed information required for reservoir modelling is usually not resolved by the near offset wavefield due to the seismic wavelength of the reflection seismic signals and their short transit time through the reservoir interval.

The differential wide aperture seismic (DWAS) technique uses long offset diving waves rather than near-offset reflections. Diving waves with their turning point in the vicinity of the hydrocarbon reservoir zone, and with their ray-paths travelling in a near-horizontal attitude, are particularly sensitive to changes in the gradient of the wavespeed near of the ray.

The DWAS technique measures changes in the recorded wavefield over an interval of time during which there has been a change induced in reservoir fluid pressure - either due to production depletion, production shut-in or fluid injection. The resulting difference in effective stress within the reservoir induces changes in the stress/strain conditions within the surrounding rock strata. Consequent alteration in the wavespeed within these rocks is detected by measuring differences in the travel path, travel time, amplitude, and phase of the diving waves. The DWAS technique maps those portions of the reservoir that have responded to the changes in reservoir fluid pressure using this distinct variation in the wide aperture wavefield.