Palaeo-Stress Directions as a Guide for Fault Conductivity Prediction in 3-D Petroleum Systems Modelling

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3D petroleum generation, expulsion, migration and accumulation have been modelled in the Bass Basin, Tasmania, Australia. Model construction and calibrations were performed using all available data (e.g. seismic, lithology character and reservoir and/or sealing properties, temperature, pressure, source rock kinetics, etc.). Fault conductivities within migration and pressure models were given special attention and tested according to fault orientation in relation to palaeo-stress directions. Periods of fault reactivation, accumulation breaching and leakage breakthrough were calibrated against present-day accumulations and empty traps.

Migration models of the Bass Basin support permeable faults in the northeastern region of the basin during Miocene inversion, which resulted in breaches within deeper accumulations and migration to upper reservoir sands and in several cases leakage through the regional seal. N-S and NNE-SSW striking faults were subjected to strike-slip movement and/or compressional reactivation due to their suitable orientation to the direction of the compressional stresses during latest Late Oligocene and Miocene periods. Common NE-SW striking faults in the basin were not affected by the same compressional event.

3D Migration model results suggest, most faults can turn to barriers for petroleum migration soon after deformation periods. Thereafter, rotation in palaeo-stress direction may have a great effect on fault conductivity for migration of hydrocarbons. Pre-existing faults or parts of them may facilitate petroleum migration during periods of suitable stress direction for reactivation despite non recognition of fault reactivation from seismic. These results may propose a framework for dealing with fault conductivity in future migration modelling studies.