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Prediction of Pore Pressure and Porosity of Unconventional Plays in Abu Dhabi Using Petroleum Systems Modeling Technology

Manhal Sirat[1]

[1]AR&D, ADCO, Abu Dhabi, UNITED ARAB EMIRATES

ABSTRACT

The petroleum systems modeling technology, which combines seismic information, well data, and geological knowledge used to predict the pore-pressure (Pp) to accurately model the evolution of sedimentary basins. The objectives of this study include a) to estimate and map the porosity and Pp in the area and b) to reconstruct the geological structures so that geomechanical forward modeling can be performed to predict potential faults.

Twelve (12) surfaces and pseudo well tops were created for thickness map gridding control. The model was built from the top surface down to Shuaiba formation. Poro-elastic model based on Biot’s law was used to simulate the rock stress, which is caused by the overburden pressure. Formation sediment decompaction method was used to reconstruct the geological structures, which depends on the compaction curve. Information regarding ages, erosion and hiatus periods was considered in the model.

This model can predict if, and how, a reservoir has been charged with hydrocarbons, including the source and timing of hydrocarbon generation, migration routes, quantities, and hydrocarbon type in the subsurface or at surface conditions. In this model, the evolution of porosity, Pp, temperature and thermal maturity was simulated. The porosity is dependent on lithology, Formations depth, and weight of the overburden sediment columns. Since the Pp is controlled by the porosity and the permeability relationship of the individual formation, low permeability results in high Pp. High overpressure is observed at the deeper part of the basin. However, the magnitude of overpressure is also related to other factors, including compaction rate and the sealing capacity of formations. As a result, it is unnecessarily that the overpressure at a deeper location is higher than that at a shallower location within the same formation. A regional reduction of Pp is observed during Paleocene is due to the erosion of Simsima formation.

The results provide an estimate of porosity and Pp in the unconventional plays to identify potential “sweat spots”, and evolution of the formations geometry by reconstructing Formations using geomechanical forward modeling. The predicted faults are largely consistent with the seismic interpretations. The estimated porosity, Pp and faults can be used for the development of static geological and dynamic reservoir models.