

## **Pore Pressure in Jurassic and Cretaceous of Kuwait: Concepts, Basin Modeling and Prediction**

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### **ABSTRACT**

Pore Pressure regimes result from complex interactions between various phenomena from micro to regional scale, controlling sediments porosity-permeability distribution, fluids characteristics and expansion. Our objective is to present a case study where basin modelling has been used for understanding and predicting the pressure field at regional scale; it covers both onshore and offshore Kuwait, from the Precambrian basement to the surface. Although Kuwait is a mature basin, the occurrence of strong overpressures (20ppg and more) within and beneath Gotnia-Hith evaporitic deposits (Kimmeridgian-Tithonian) is not fully constrained. In addition, above the salt, the distribution of overpressures in Northern Kuwait is still poorly understood. The model is calibrated with field data and geomechanical analysis of well reports. It shows that the main cause of overpressure at basin scale is the confinement of pre-salt Jurassic units. Formation waters mobilized by the sedimentary compaction (mechanical and chemical) and other fluids generated by diagenetic processes and catagenesis must escape the system. The model proves the importance of vertical fluid migration through low permeability faults and discontinuities in the Gotnia-Hith Formation. Several of these discontinuities have been mapped for the first time according to their directions and vertical extensions, thanks to a dedicated geophysical analysis performed in parallel. Local “salt windows” exist both in Burgan and Sabiriyah-Raudhatain areas. The model also shows that fluids “injected” in low porous Lower Cretaceous carbonates “propagate” the overpressure above the salt, locally forming “pressure plumes”. These results have of course consequences on our understanding of imbricated petroleum systems feeding super giant oil fields in the area. In the first place the model demonstrates that hydrocarbons generated by the prolific Najmah source rock (Callovo-Oxfordian, below the salt) can feed Marrat reservoirs (Middle Jurassic) and contribute to the charge of several Cretaceous plays. Finally basin modelling results have been used as boundary conditions for a high resolution geomechanical finite element modeling of the pressure field within the Gotnia-Hith formation itself, spatial variations of mechanical properties being defined through seismic characterization. Depending on the scale and on involved mechanisms, only integration of various approaches provides reliable enough prediction of pore pressure.