Predicting Reservoir Intervals by Looking at Fault Data: An Exploration Tool in Frontier Basins

Ramadan Ghalayini[1], Jean-Marc Daniel[2], Fadi Nader[2], and Catherine Homberg[3]

[1]UPMC-IFPEN
[2]IFPEN
[3]UPMC

Abstract

Frontier basins with limited data sets provide a great challenge and higher risk during exploration for commercial hydrocarbon accumulations. Some of the challenges are to identify and map reservoir intervals by using only seismic data. In this contribution, we show how by mapping the distribution of compaction-related normal faults in a basin, analyzing their geometries and understanding their growth history through 3D seismic characterization can be of high importance during assessment of the basin's petroleum system in general, and reservoir intervals in particular. Thus structural analysis is an essential tool to reduce uncertainties during exploration.

The Levant Basin is a typical frontier province with a limited dataset. It contains exceptional NW-SE trending normal faults having throws up to 300 m and observed in the Oligo-Miocene units. Interpretation of high quality 3D seismic data indicates that these faults are thought to be compaction related making them a particular type of polygonal fault systems linearly oriented due to a regional anisotropic stress field. Their evolution and growth have been affected by strong mechanical stratigraphy in the Oligo-Miocene units, with nucleation of fault segments in incompetent units, while competent units were barriers to fault propagation.

Fault data interpretation suggest that the reservoirs in the deep Levant Basin are located along the base of the Miocene sequence as it correlates with a ~100 m thick sandy unit. In contrast, in the northern part of the basin close to the Lattakia Ridge, the reservoirs are most likely located in the Upper Miocene. The presence of these faults implies that the remainder of the Oligo-Miocene unit consists of fine grained and soft sediments such as clay, chalk or very fine-grained sand, which is directly correlated with the distribution of these normal faults.