A Kind of Effective Oil Layer Prediction Method in Pre-Drilling Stage in Low Exploration Rift Basin

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ABSTRACT

In low exploration rift basins, such as Muglad basin in Sudan, it is hard to carry out accurate oil layer prediction as per low-quality seismic data and lack of drilling wells data, which has led to few oil & gas discoveries during exploration stage. In this research, based on analysis on different kinds of data like post stack seismic data, well logging curves, microfaices, high level stratigraphy sequences subdivision and comparing with different reservoir prediction methods and hydrocarbon detection methods, a new kind of effective oil layer prediction method in pre-drilling stage is composed specially for low exploration rift basins with relatively high successful drill result. The workflow could be divided into five stages. Firstly, resolution improvement was done using spectrum shaping process using reservoir-sensitive well-logging curves as quality control in target formation, the seismic resolution would be improved to show sandstone variance vertically and horizontally. Secondly, accurate structure model is set up in which target layers should be clipped by different levels of faults into different fault blocks and led to seismic inversion calculation constrained in certain fault blocked areas. Thirdly, accurate microfacies identification would be done based on high level cycles, well-correlation, sample core observation and analysis, which will be a direct reference for parameters estimation of geostatistics. Fourthly, we combined determined seismic inversion, waveform and frequency-subdivisionnversion based on artificial natural network and geostatictics inversion together to conduct accurate prediction on thin sandstone layers. In this stage, determined seismic inversion is used as a trend control by artificial waveform inversion, which will reduces the uncertainty, and then we could get reservoir horizontal variance from ANN waveform inversion as rules of lateral control used by geostatistics inversion. The ANN waveform inversion is also used by calculation on low-frequency trend merging with geostaticitcs inversion and now we get a more reliable inversion on thin sandstone layers. Finally, we used a new hydrocarbon detection method based on abnormal in low-frequency part, which is used only if there is no effective high frequency proportion and low frequency proportion has good response. By continues drilling activities, this new method has been proved an effective way to improve exploration successful rate in low exploration rift basins.