J Geol Geophys 2018, Volume 7
DOI: 10.4172/2381-8719-C1-018

Seismic amplitude and frequency analysis for hydrocarbon prediction and fluid contact delineation in a Niger delta oil field

Michael Emenike Egbunike[1] and Kalu Mosto Onuoha[2]
[1]Anambra State University, Nigeria
[2]University of Nigeria, Nigeria

The use of amplitude and frequency of the seismic wavelet for the direct detection of hydrocarbons have been known in the petroleum industry for decades. Common Direct Hydrocarbon Indicators (DHI) includes amplitude changes, phase shifts and polarity reversals. The present study was born out of the need to improve the knowledge of the applicability of DHIs in exploration and production in the Niger delta petroleum province. The objectives of study were to: (1) Demonstrate the use of amplitude extraction and spectral decomposition techniques in the determination of fluid contact, (2) show that seismic amplitude is conformable to structure, (3) predict possible type of hydrocarbon from Gassmann's fluid substitution modeling and amplitude study and (4) demonstrate the feasibility of detecting a thin oil rim within a thick reservoir that from normal seismic interpretation would have been missed out. The well and 3D seismic data were loaded into the openwork's and 123 DI databases. A quality check was performed on the data to ascertain the data quality. The seismic-to-well match was first carried out and having chosen the D62 reservoir as the main target in this field, Gassmann's fluid substitution modeling was then performed in the reservoir. A Monte Carlo simulation approach was applied in the D62 reservoir. Amplitude extraction was done on the interpreted seismic loop and followed with the spectral decomposition of the D62 reservoir. Amplitude versus time cross plot was carried out while the uncertainty analysis was also used. The generated synthetic seismogram gave a good match to the real one when a time shift of -30 ms was applied. The synthetic amplitude measurement in the Gassmann's fluid substitution modeling of the D62 reservoir gave very high amplitudes for gas synthetics and very low amplitudes for brine. The ratios of the amplitude of the synthetics in the reservoir indicated that the ratio of gas to brine has the highest value compared to the ratios of oil to brine and gas to oil. The Gassmann's fluid substitution modeling predicted the fluid type that was originally in the reservoir as gas. Monte Carlo simulation showed that the gas model has the highest amplitude followed by the oil and finally the brine. Frequency analysis showed that brine can be separated from the hydrocarbon, but the oil and gas might not be separated. The amplitude measurement from the Monte Carlo's histogram plot showed that there was an increase in the amplitude from the brine (1.71) to oil (3.10) and the highest amplitude occurred in the gas (4.38). Amplitude extraction allowed for the generation of a time map and an amplitude map, which revealed a faulted roll-over anticlinal structure. The hydrocarbon contact at 2690 ms shown by the amplitude and frequency maps also agreed with the contact established in the amplitude versus time cross plot. The uncertainty modeling confirmed the possibility of finding an oil thickness of 5 m within the D62 reservoir. This is a result from an economic point of view is significant.

me_egbunike2006@yahoo.com

Notes: