Low Gas-Saturation Effect on AVO Response

Perveiz Khalid[1], Farrukh Qayyum[2], and Daniel Broseta[3]
[1]University of Pau, France,
[2]dGB Earth Sciences Enschede, The Netherlands.

Since the last three decades, AVO analysis has been applied as fluid discriminator and direct hydrocarbon indicator. However, the conventional AVO analysis does not give good results in reservoirs with low gas saturations. The analysis reveals that the P-wave velocity of a fluid saturated rock is over-estimated by the conventional models. These conventional models ignore the heat and mass transfers between the liquid and gas phases, which are caused by pore pressure perturbations. These transfers do have very significant effects on the seismic parameters of reservoir rocks with low gas saturation. Therefore, these effects need to be accounted for during the interpretation of the seismic events and during forward modeling in these reservoir rocks with low gas saturation. The conventional model is therefore corrected by considering the thermodynamic properties of the fluid phases. This adjusted model is then applied on a producing field located in the North Sea. It shows that the AVO response is highly affected by pressure related changes in fluid properties. The results show that a velocity push down effect appears, as the free gas saturation generates stronger AVO response than obtained by a conventional AVO model. Therefore, it is proposed that such response is a helpful method to detect primary leakage of gas from geological structures, to model free gas effects on seismic attributes, and to distinguish areas with low gas saturation from areas with higher and possibly commercial gas saturation.