Seismic wave attenuation in carbonate rocks: challenging but promising parameter for petroleum exploration.

*Fateh Bouchaala[1], Mohammed Yussuf Ali[1], Jun Matsushima[2]

1. The Petroleum Institute, 2. University of Tokyo

Seismic wave attenuation is an important parameter in geophysical studies, thanks to its sensitivity to physical parameters of the subsurface such as, fluid content, lithology and fractures. So, an accurate estimation of this parameter can help to enhance the geophysical interpretation and also to increase signal to noise ratio of seismic data. However, getting an accurate seismic attenuation profiles is challenging due to its high senstivity to noise and immaturity of the methodology. The challenge is bigger in the case of carbonate rocks media, due to their high heterogeinity and complex lithology.

In this study we estimate seismic wave attennuation from different oilfields having different locations in Abu Dhabi. The subsurface of this region is mainly composed of carbonate rocks. We implemented a robust processing workflow and we developed a new methods, this in order to get an accurate and high depth-resolution attenuation profiles from Vertical Seismic Profiling (VSP) and sonic data. The results show a significant contribution of scattering on total attenuation, this can be interpreted by high the heterogeinity and the complex lithology of carbonate rocks. The scattering and intrinsic attenuation show a sensitivity to fractures, fluid and clay content. This is a good indication about the attenuation potential for reservoir characterization and to enhance geophysical interpretation. The cross plots showed a link between sonic attenuation and petrophysical logs , which means that these latter can be predictible from the attenuation.

The results obtained herein can be improved if we overcome the limitation of the conventional approach, which uses well-log velocities and densities to calculate scattering attenuation based on the assumption that the total attenuation is a linear summation of intrinsic and scattering attenuation. It is important to confirm the validity of the assumption of strong scattering in order to adequately estimate the scattering attenuation from velocity or acoustic impedance data. We proposed a new approach to separate between scattering and intrinsic attenuation based on reforming the modified median frequency shift (MMFS) (Suzuki and Matsushima 2013) method with seismic interferometry (SI) (Matsushima et al 2016) under the assumption that intrinsic and scattering attenuation are frequency independent and frequency dependent, respectively. The numerical results demonstrate the superiority of the proposed method as compared to the conventional approach and the importance of optimizing parameters in the application of preprocessing filters to balance the resolution power and noise reduction effect.

Keywords: seismic wave attenuation, carbonate rocks, fluid and fractures, mechanism

