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Estimation of fluid contact in terms of attenuation

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Sonic logging has been widely used for many years to acquire physical properties of formations in the vicinity of hydrocarbon reservoirs. When gaseous phase exists in the formation fluid, the compressional waves traveling through the formation could be strongly attenuated due to low bulk modulus of gas in the fluid, while the shear waves are not. For acquiring physical properties of fluid in the formation, Biot physics or poroelastic analysis would be the best method. Among the available technologies, quality factors based on the Biot's equation could be used. Although the Biot's theory considers the viscous attenuation induced at the interface between pore wall and fluids, the intrinsic attenuation caused by the internal friction in the matrix is ignored.

In the present study, adding the intrinsic attenuation we investigate if we take the effect of the viscous attenuation from the acquired quality factor, and then, on the basis of the result, if we estimate the fluid contact (e.g. gas-oil contact and oil-water contact). We employ a 2D finite-difference scheme to simulate seismic wave propagation in a poroelasic medium. The intrinsic attenuation is included in our model using a filter for frequency-independent quality factor (constant-Q). We then achieve the results of compressional and shear wave in our numerical simulations. Our results show that on compressional and shear waves, obtained the quality factors different from each other. We acquire the effect of the viscous attenuation by subtracting the quality factor of shear wave from the quality factor of compressional wave. We conclude that the effect of viscous attenuation is extracted and the gas-oil contact is estimated.

Keywords: Q, attenuation, poroelastic, Biot, sonic logging