Amplitude Versus Offset (AVO) Modeling as a Tool for Seismic Reservoir Characterization of the Semliki Basin

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Abstract : The Semliki basin has become a frontier for petroleum exploration in recent years. Exploration efforts have resulted into extensive seismic data acquisition and drilling of three wells namely; Turaco 1, Turaco 2 and Turaco 3. A petrophysical analysis of the Turaco 1 well was carried out to identify two reservoir zones on which AVO modeling was performed. A combination of seismic modeling and rock physics modeling was applied during reservoir characterization and monitoring to determine variations of seismic responses with amplitude characteristics. AVO intercept gradient analysis applied on AVO synthetic CDP gathers classified AVO anomalies associated with both reservoir zones as Class 1 AVO anomalies. Fluid replacement modeling was carried out on both reservoir zones using homogeneous mixing and patchy saturation patterns to determine effects of fluid substitution on rock property interactions. For both homogeneous mixing and saturation patterns, density (ρ) showed an increasing trend with increasing brine substitution while Shear wave velocity (Vs) decreased with increasing brine substitution. A study of compressional wave velocity (Vp) with increasing brine substitution for both homogeneous mixing and patchy saturation gave quite interesting results. During patchy saturation, Vp increased with increasing brine substitution. During homogeneous mixing however, Vp showed a slightly decreasing trend with increasing brine substitution but increased tremendously towards and at full brine saturation. A sensitivity analysis carried out showed that density was a very sensitive rock property responding to brine saturation except at full brine saturation during homogeneous mixing where Vp showed greater sensitivity with brine saturation. Rock physics modeling was performed to predict diagnostics of reservoir quality using an inverse deterministic approach which showed low shale content and a high degree of shale stiffness within reservoir zones.

Keywords : Amplitude Versus Offset (AVO), fluid replacement modelling, reservoir characterization, AVO attributes, rock physics modelling, reservoir monitoring
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