Seismic Characterization and Rock Physics Modeling of Hydrate-Bearing Sediments of the Continental Margin of Pakistan

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Abstract

Naturally occurring gas hydrates composed of methane, propane or ethane molecules and water molecule are potential future energy source. A large amount of methane gas hydrate is present in the world sedimentary basins. A significant amount of gas hydrates is interpreted through seismic reflection data to be present in the sediments of the convergent continental margin of Pakistan. However, the seismic character of these hydrates bearing sediments was not well understood. Rock physics modeling is adopted to define seismic behavior of these sediments. The rock physics model based on the effective medium theory was found to be good one for seismic characterization of the hydrate-bearing sediments. Amplitude versus offset (AVO) attributes of bottom simulating reflector (BSR) is coupled with rock physics models to characterize the seismic properties of gas hydrate bearing sediments. Based on this coupling the saturation of gas hydrates and free gas preset beneath BSR of the continental margin of Pakistan is quantified. The choice of rock physics model directly affects the shallow gas hydrate saturation estimates. The crossplots of various AVO attributes indicate the presence of free gas below the BSR. However, the distribution of this free gas is poorly known because of lack of drilled hole data. The results reveal that seismic velocities and density of hydrate-bearing sediments are highly affected by the saturation of gas hydrates, which can be guide to seismic interpretation of BSR. The results are based on the assumption that the free gas is homogeneously distributed throughout the BSR.