Quantifying Gas Hydrate Resources from Cumulative Seismic Attributes, Hydrate Ridge, Offshore Oregon

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Application of an advanced type of seismic attribute ("cumulative seismic attribute = CATT") detects gas hydrate saturations exceeding 20% beneath Hydrate Ridge, offshore Oregon. CATT is based on case-specific rock physics transforms that portray bulk properties of the gas hydrate stability zone. One such transform that links elastic wave velocities, porosity, fluid compressibility, mineralogy, and effective pressure of unconsolidated sediment is the "soft-sand model." Moreover, this soft sand model populates part of the matrix with gas hydrate. The resultant porosity reduction with increasing gas hydrate saturation leads to higher impedances. However, geological scenarios may occasionally arise that result in high impedance contrasts from causes other than actual hydration ("false positives"). Nonetheless, where genuine, hydration generally affects the entire section occupied by sands, silts, and shales, most of which occurs within a narrow window no more than 30 to 50 milliseconds above the BSR. Hydration is highest in layers with low-V_{CLAY} (30% to 40%). Interestingly, for a case study reservoir sand from the eastern flank of the dome, geobodies with impedances exceeding 2,800 kgm^2s^{-1} occur low on structure in a region characterized by en échelon normal fault escarpments. This observation suggests a genetic link between faulting and hydration. Since high gas hydrate saturations are not encountered toward the structural highs of the sand, this deficit may indicate a past gas supply problem or partially sealing faults, or a combination of both alternatives. Volumetric calculations of the CATT attribute give resource estimates of approximately 720 Bcf for a 45 km^2 area. However, these volume calculations should be viewed with caution because of an incomplete data set from which impedance inversion was performed.