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Estimation of the gas-hydrate resource volume using 3-D seismic and well-log data in the Ulleung Basin, East Sea, Korea

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We analysed 3-D seismic data and well-log and core data to estimate the gas-hydrate and in-place gas volumes of a small area in the Ulleung Basin. The UBGH2-6 well was drilled in the study area during the Second Ulleung Basin Gas Hydrate Drilling Expedition (UBGH2) in 2010. The UBGH2-6 well penetrated gas hydrate-bearing turbidite sands from 110 to 155 m below seafloor. First, the relationships between the P-wave velocity (V_p), S-wave velocity (V_s), density, and pore-space gas-hydrate saturation (0% to 100%) for all depths points of the gas-hydrate bearing zone in the well were established from the rock physics model, using the V_p and porosity logs and the mineral compositions of the core samples. The relationships allowed the estimation of the gas-hydrate saturation in the well from the V_p log. Then, the P-impedance (I_p) volume for the 3D seismic data was obtained from simultaneous inversion. The I_p volume for the gas-hydrate bearing zone was divided into 28 sublayers to take into account the spatial variations in gas-hydrate saturation. The porosity of each sublayer was assumed to be the same as the porosity averaged for the corresponding sublayer in the well. The gas-hydrate saturation of the gas-hydrate bearing zone was computed from the I_p volume using the relationship between I_p and gas-hydrate saturation. The gas-hydrate saturation time volume is the product of the porosity volume and the pore-space gas-hydrate saturation volume. Each time sample of the gas-hydrate saturation volume corresponds to a 25 m$\times$6.25 m$\times$1 ms cell. The gas-hydrate saturation time volume was converted into the depth volume using V_p that corresponds to gas-hydrate saturation at each time sample. The summation of the gas-hydrate saturation for all cells is the estimate of total gas-hydrate volume (about 8.43×10^8 m^3) and the estimate of the in-place gas volume is about 1.38×10^{11} m^3.