Geophysical Research Abstracts
Vol. 14, EGU2012-6619-1, 2012
EGU General Assembly 2012

Gas hydrate concentration assessments and seismic facies analyses in the Ulleung Basin, Korea

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A number of geological and geophysical surveys in the Ulleung Basin, the east coast of Korean Peninsula, have been conducted by the Gas Hydrate R&D Organization (GHDO) of Korea since 2000 in order to confirm the presence of gas hydrate, and to determine its distribution. Over 6,600 km of 2-D and 700 km2 of 3-D seismic data were collected; moreover, two drilling expeditions (UBGH-1 and UBGH-2) were carried out in 2007 and 2010. Logging While Drilling (LWD) and Wireline Logging (WL) data were obtained as well as piston cores. Here we present results from selected site, using LWD log data obtained during UBGH-2 to characterize the gas hydrate occurrence. Gas hydrate saturations (Sh) at Sites UBGH 2-2-2, 2-5, 2-6, and 2-10 were calculated using two different methods: (1) Archie's relation with resistivity; (2) P-wave velocity profile with effective medium theory to understand the local (vertical) hydrate concentration. Gas hydrate saturation varies between 5 to 20 % at most sites on average, and it increases to about 80 % at UBGH 2-6 and 2-10 within certain intervals. In an effort to evaluate the gas hydrate potential in the Ulleung basin, we present results on how best to extrapolate the borehole information laterally for regional gas hydrate concentration assessments and utilize seismic facies analyses to link hydrate occurrence to sediment type and depositional environment. We first evaluate cross plots of log-derived physical properties (e.g. density, porosity, and gamma ray) as well as cross-plots of log and seismic properties (e.g. reflection amplitude, frequency) to determine any relationships between these various properties in both non-hydrate and with-hydrate conditions that may be useful for regional prediction of gas hydrate content and sediment type. These cross-plots help then to optimize seismic facies-prediction that was applied to a 3-D seismic data volume in the Ulleung Basin. The best seismic parameters to use for facies prediction include acoustic impedance, envelope, and shale indicator.