

Paper Number: 2190

Seismic characteristics of gas hydrate and free gas in the northwest Ulleung Basin, East Sea

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Based on the interpretation of 3D seismic data acquired in the northwest Ulleung Basin, East Sea, the sedimentary sequence including the gas-hydrate stability zone (GHSZ) consists of five seismic units separated by regional reflectors. Units 1 to 4 show low amplitude because they are dominated by homogeneous hemipelagic muds [1]. Unit 5 is characterized with high amplitude due to the hemipelagic muds intercalated with turbidite sands including the gas hydrate occurrence zone (GHOZ). An anticline is present in the study area that documents activity of many faults.

The seismic indicators for the presence of gas-hydrate include bottom simulating reflector (BSR) and acoustic blanking which is coincident with high resistivity and velocity logs. On the basis of seismic characteristics and gradient of sedimentary strata, the GHOZ is divided into four classes: (1) dipping strata upon strong BSR, (2) dipping strata below strong BSR, (3) parallel strata with acoustic blanking, and (4) parallel strata below weak BSR.

Seismic attributes such as reflection strength and instantaneous frequency are computed along the GHOZ in order to demonstrate the presence of gas-hydrate and free gas. Low reflection strength and high instantaneous frequency are identified above the BSR, indicating the gas-hydrate occurrence. A remarkable high reflection strength and low instantaneous frequency indicate the presence of free gas below the BSR.

Considering the 3D distribution of gas-hydrate and free gas, two gas migration processes can be suggested: (1) stratigraphic migration through the dipping, permeable strata, and (2) structural migration through the faults from below the GHSZ.

References:

[1] Bahk et al. (2013) Marine and Petroleum Geology 47: 20-42

