

Resource Assessment of Methane Hydrate by Probabilistic Approach in the Eastern Nankai Trough

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Methane hydrate (MH) in the Nankai Trough is a potential natural gas resource, however, the volume, distribution, and occurrence of MH in this area is poorly understood. Resource assessment of methane hydrate in the eastern Nankai Trough was conducted through probabilistic approach using METI (Ministry of Economy, Trade and Industry) 2D/3D seismic survey data (2001, 2002) and drilling survey data from METI exploratory test wells 'Tokai-oki to Kumano-nada' in 2004. We have extracted more than 10 prospective 'MH concentrated zones'¹⁾ characterized by high resistivity in well log, strong seismic reflectors, seismic high velocity, and turbidite deposit delineated by sedimentary facies analysis.

The amount of methane gas contained in MH bearing layers was calculated using volumetric method for each zone. Each parameter, such as gross rock volume (GRV), net-to-gross ratio (N/G), MH pore saturation (Sh), porosity, cage occupancy, and volume ratio was given as probabilistic distribution for Monte Carlo simulation, considering the uncertainty of these evaluations.

The GRV for each hydrate bearing zones was calculated from both strong seismic amplitude anomaly and velocity anomaly. Time-to-depth conversion was conducted using interval velocity derived from Seismic Vision While Drilling (SVWD). Risk factor was applied for the estimation of the GRV in 2D seismic survey area considering the uncertainty of seismic interpretation. The N/G was determined based on the relationship between LWD resistivity and grain size in zones with existing wells²⁾. Seismic facies map created by sequence stratigraphic approach³⁾ was also used for the determination of the N/G in zone without well controls. Porosity was estimated using density log, together with calibration by core analysis. The Sh was estimated by the combination of density log and NMR log, together with the calibration by observed gas volume from onboard MH dissociation tests²⁾ using Pressure Temperature Core Sampler (PTCS). The Sh in zone without well control was estimated using relationship between seismic P-wave interval velocity and Sh from NMR log at well location.

Total amount of methane gas in place contained in MH in the eastern Nankai Trough within survey area was estimated to be 40 tcf as Pmean value (P90: 10 tcf, P10: 83 tcf). On the other hand, gas in place for MH concentrated zone was estimated to be 20 tcf as Pmean value (P90: 6.3 tcf, P10: 39 tcf), which was the half of total amount. This amount, 20 tcf, is also corresponded to the amount of methane in the eastern Nankai Trough (7,000km²)⁵⁾ evaluated based on the criteria by Satoh et al. (1996)⁴⁾. Considering the annual consumption of natural gas in Japan in 2005 (2.9tcf from BP Statistical Review, 2005), the total amount of gas in the eastern Nankai Trough in our study, 40 tcf, is corresponded to 14 years gas consumption. However, areal extent of BSR in our study in the eastern Nankai Trough (4,687km²) occupied only about 10% of assumed whole BSR of offshore Japan (51,600km²)⁵⁾.

Probabilistic distribution of MH resource for each MH concentrated zones and MH bearing layer shows basically normal or lognormal distribution. Sensitivity analysis indicated that the N/G and Sh have higher sensitivity than other parameters, and they are important for further detail analysis.

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4) Satoh, M. et al., 1996, Jour. Geol. Soc. Japan, Vol.102, No.11, p.959-971.

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