An Appraisal Project for Offshore Methane Hydrate in Japan*

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Abstract

BSR (Bottom Simulated reflector), which is considered as an index of methane hydrate, is detected in many seismic records in offshore Japan. According to a certain trial calculation, the amount of methane resource can be 250 tcf in place. It is one of the largest potential hydrocarbon resources for Japan. Therefore, as a part of Japan's Methane Hydrate Exploitation Program, Japan National Oil Corporation (JNOC) has been generating an appraisal project for offshore methane hydrate. This project consists of 2D and 3D seismic, as well as a series of exploratory test wells. 2D (2800 km) and 3D (1960 km^2) seismic were acquired in 2001 and 2002. Exploratory test wells are expected to be drilled in early 2004. Data from those activities provide input data for calculating the amount of resource and information for site selection for a future production test well.

Geologic Setting and Distribution of BSR

Japan is located on an island arc complex. Pacific coast (east and south) of Japan is on the forearc side, and accretionary prisms are formed in offshore Pacific. Forearc basins in offshore Japan have been considered as a low potential area for hydrocarbons. Actually, most of major oil and gas fields in Japan are in backarc basins. However, a large part of BSR's is found on the forearc side. In particular, the area of offshore Tokai to Shikoku called "Nankai Trough," contains the largest cluster of BSR (Figure 1). Most of the BSR's are found in Pliocene to Pleistocene pelagic sediments.

Previous Activity

Since 1995, JNOC has been promoting a research consortium on methane hydrate. As a first target, offshore Tokai was chosen, based on an existence of clear BSR, water depth, and distance from the coast. In terms of exploration, there were high-resolution 2D seismic (1996) and "MITI Nankai Trough" exploratory test well (2000). JNOC also joined the Mallik Consortium. Mallik 2L-38 (1998) was drilled in the Mackenzie Delta, Canada, to take core samples and obtain logging data from methane hydrate layers below permafrost. Through these activities, keys to identify methane hydrate from well logging have been developed.

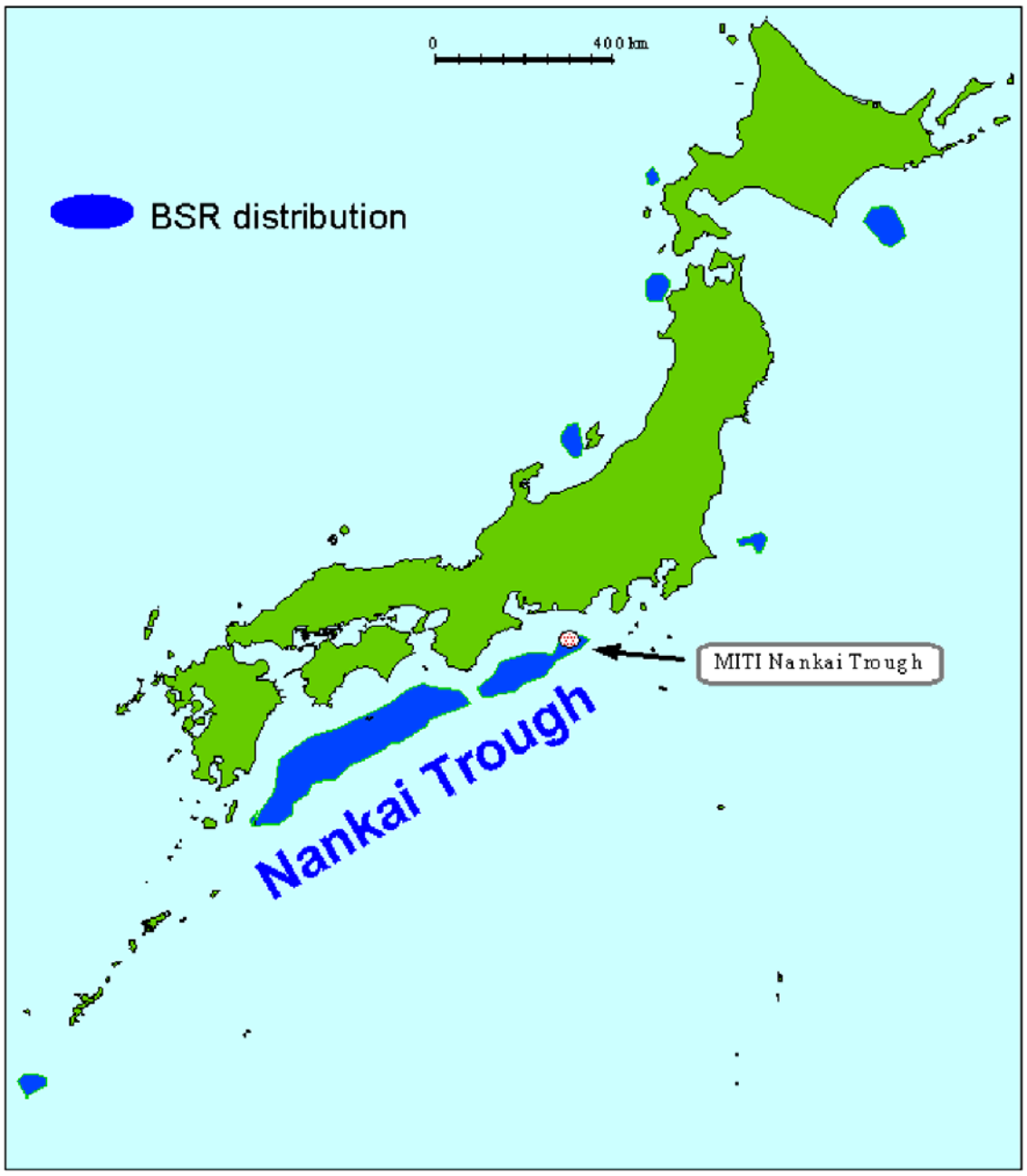

Figure 1. BSR distribution around Japan .

Summary of "MITI Nankai Trough"

"MITI Nankai Trough" was drilled at one of a forearc seamount offshore Tokai. Figure 2 shows a seismic section (NWSE) through the well. Clear BSR's are found below the sea bottom, cross-cutting bedding. "This well" consists of 2 pilots hole for safety, 2 holes (main hole, post-survey well -2) for coring, and 2 holes (post-survey well -1, -3) for logging. Distances between holes range from 10m to 100m. These holes allow the following points to be made:

(1) Lower limit of methane hydrate corresponds to the depth of BSR on seismic.
(2) Methane hydrate exists only in sand layers, filling pore spaces between grains.
(3) Methane hydrate is concentrated from the lower limit of its stability zone upward 70m.
(4) The methane hydrate is composed of biogenic methane.

(2) and (4) are different from other reports on methane hydrate in the Gulf of Mexico or offshore Oregon. To clarify mechanisms of migration and concentration of methane hydrate or to assess methane hydrate resource, unique studies would be needed.

Figure 3 shows a schematic well correlation section of the methane hydrate concentration zone. It shows a top of methane hydrate or a net pay at each well dependent on the concentration in, and development of, sand layers.

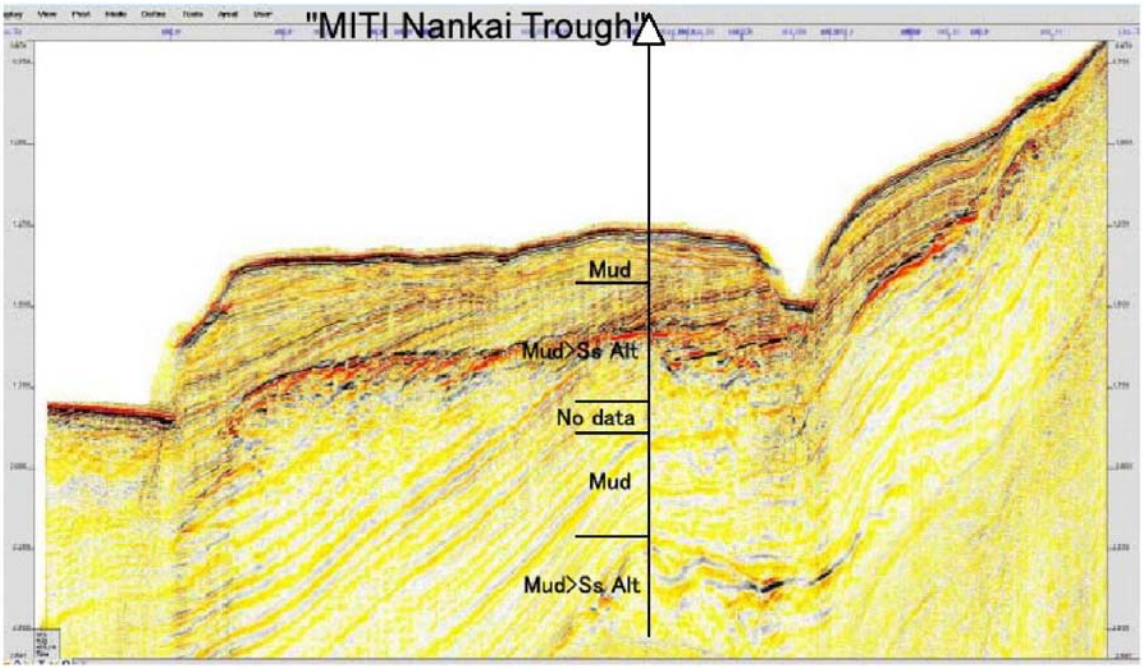

Figure 2. Seismic section through "MITI Nankai Trough."

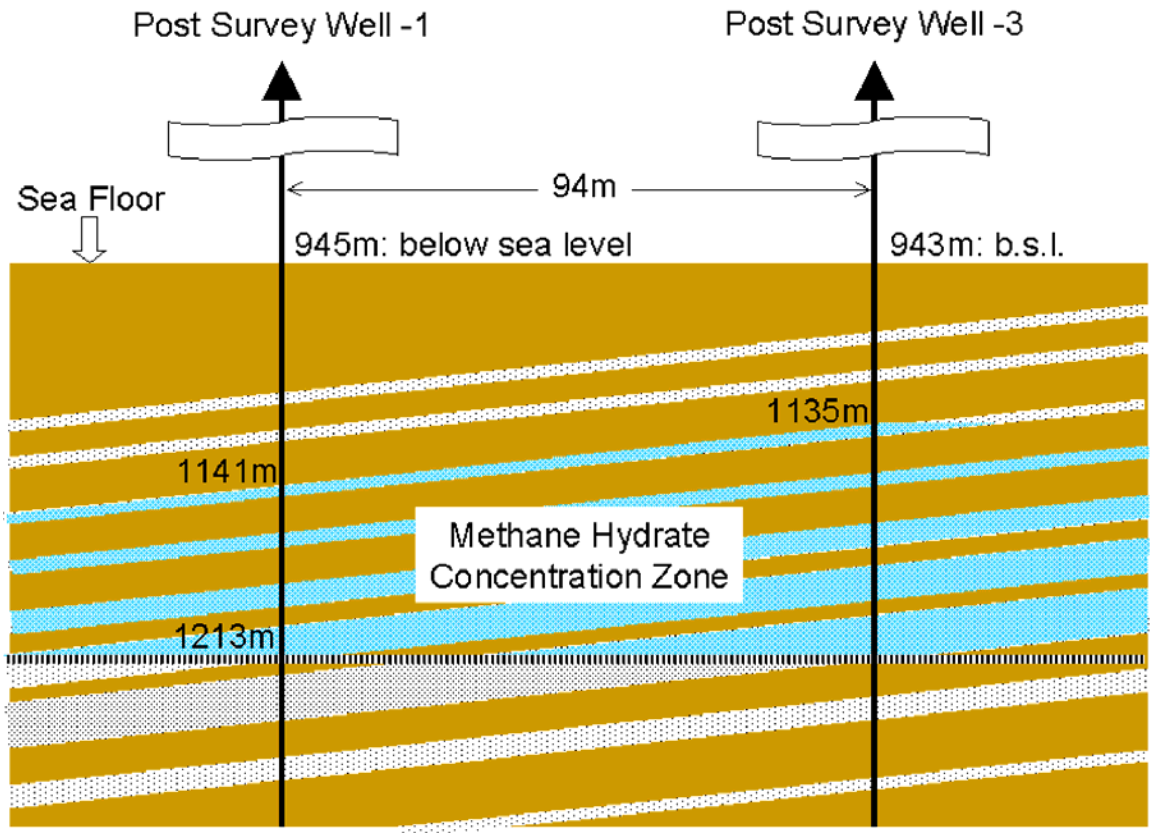

Figure3. Methane hydrate concentration zone in "MITI Nankai Trough."

"Japan's Methane Hydrate Exploitation Program"

Japan's government initiated a program for methane hydrate in July, 2001. The first six years is a period to assess methane hydrate resources. To be clarified in regard to methane hydrate are the questions: Where, How formed, and How much? To assess the resource amount, we need to know the area of distribution, net pay, porosity, hydrate saturation, formation volume factor, and cage occupancy. Concerning an area of distribution, we can regard it to be equal to the area of BSR. Variation of the porosity between methane hydrate layers is not marked (value approximately 30%). For the formation volume factor, 172 is usually used. Cage occupation, a technical term in chemistry, would be approximately 0.9. Thus, the remaining parameters for which we need values are net pay and hydrate saturation. We expect that they may be estimated from acoustic velocity anomalies on seismic. Figure 4 shows a log curve of acoustic velocity in "MITI Nankai Trough." We know the zones of anomalously high velocity correlate with a combination of net pay and hydrate saturation. However, the correlation between hydrate saturation and acoustic velocity may not be linear. It depends on the filling type of hydrate in the pore space. This point will be next challenge.

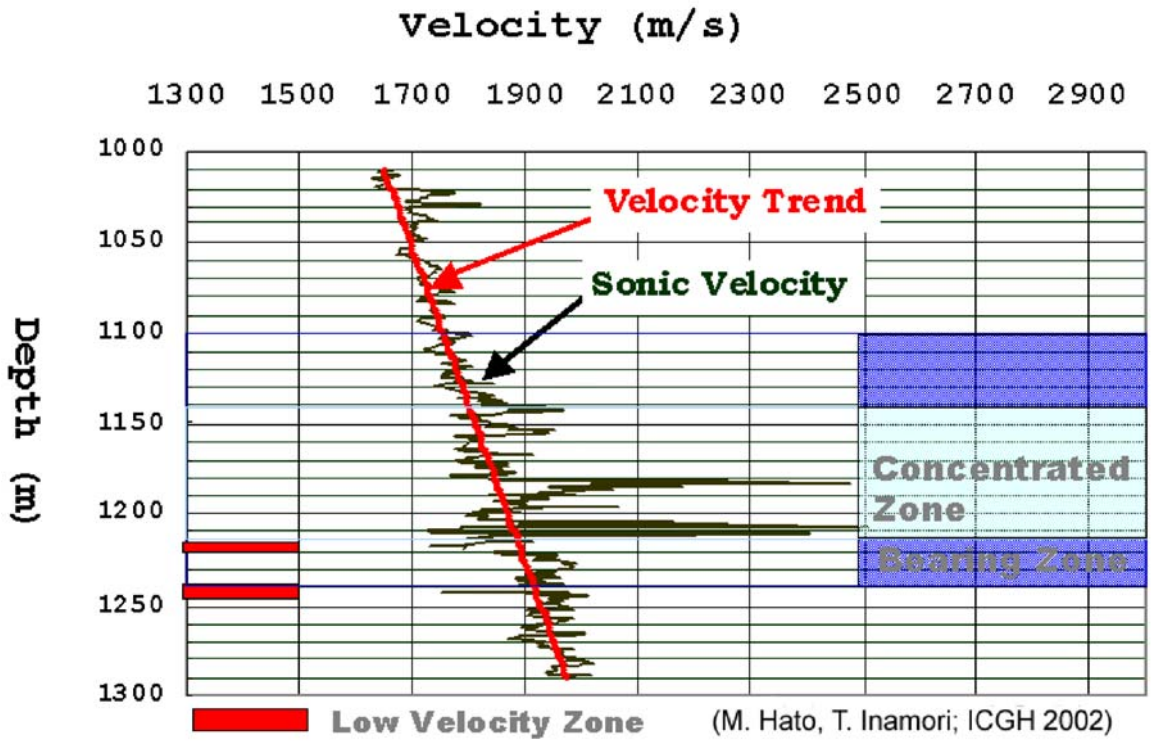

Figure 4. Acoustic velocity in "MITI Nankai Trough" (from H. Hato and T. Inamori, presentation, 4th International Congress on Gas Hydrates, May 19-23, 2002).