

Mechanical Properties of Sandy Sediment Containing Marine Gas Hydrates in Deep Sea Offshore Japan

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ABSTRACT

MH21 research consortium of Japan conducted off-shore drillings to survey gas hydrate in Tokai-oki and Kumano-nada area in early 2004 and recovered drill cores of gas hydrate bearing sediment successfully. Mechanical properties of sandy core samples containing natural gas hydrate have been investigated by tri-axial compression test. The increase in tri-axial compressive strength against pore saturation of gas hydrate has been confirmed. The trend of strength increase shows good agreement with the previous results obtained from Toyoura sand containing laboratory-formed synthetic gas hydrate. The secant elastic modulus at 50% of peak strength of natural samples, however, lowered comparing with synthetic gas hydrate sand. No significant relationship has been confirmed between Poisson's ratio and pore saturation of gas hydrate. This relationship can be supported by the same results which have been obtained from the test of Toyoura sand containing synthetic gas hydrate with regard to Poisson's ratio.

KEY WORDS: marine gas hydrate; sandy sediment; natural core sample; hydrate saturation; tri-axial compression test; tri-axial compressive strength; Toyoura sand

INTRODUCTION

Discovery of gas hydrate in a global scale has attracted publicity, while the prospect of commercial production of gas hydrate is yet uncertain technically due to the lack of real understandings of gas hydrate and hydrate bearing sediments in nature. We have conducted many tri-axial compression tests so far employing sand specimens containing laboratory-formed synthetic gas hydrate. Mechanical properties of those synthetic hydrate sand have been confirmed approximately from laboratory tests (Masui et al., 2005). However, discussion on essential difference between natural gas hydrate sediment and synthetic hydrate sand has remained unsolved in our experimental results.

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sediment successfully. Marine gas hydrate has been confirmed mainly in sandy drill cores retrieved from mud and sand alternation strata. It is our first experience to perform tri-axial compression test on natural hydrate core samples so as to have better understanding of hydrate bearing sediment in nature. In this paper, mechanical properties of sandy sediment containing natural gas hydrate have been presented and mechanical characteristics of hydrate bearing sediment are discussed comparing with Toyoura sand containing synthetic gas hydrate.

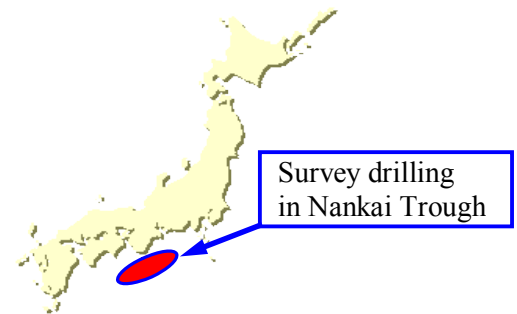


Fig.1 Location of survey area

EXPERIMENTAL PROCEDURE

Preparation of Natural Hydrate Core Specimen

Most of natural gas hydrate cores have been preserved in storage containers filled with liquid nitrogen for the preliminary scrutiny at AIST (National Institute of Advanced Industrial Science and Technology) Hokkaido centre. An X-ray scan of drill core shows clear images of cracks and bubble holes along the side surface as shown in Fig.2. Depressurization and/or stress relaxation due to recovery from the deep sea drilling is the cause of such damage to natural gas hydrate cores. Thus, those natural cores have been disturbed more or less by drilling performance and reshaping process is needed for tri-axial compression test. For the preparation of test specimen, a natural gas hydrate core of approx. 1000mm in length and 70mm in diameter has