

A comparative analysis of the mechanical behavior of carbon dioxide and methane hydrate-bearing sediments

MASAYUKI HYODO¹, YANGHUI LI^{1,2,*}, JUN YONEDA³, YUKIO NAKATA¹, NORIMASA YOSHIMOTO¹, SHINTARO KAJIYAMA¹, AKIRA NISHIMURA¹ AND YONGCHEN SONG²

¹Department of Civil and Environmental Engineering, Yamaguchi University, Tokiwadai 2-16-1, Ube, 755-8611, Japan

²Key Laboratory of Ocean Energy Utilization and Energy Conservation of Ministry of Education, Dalian University of Technology, Dalian, 116024, China

³The National Institute of Advanced Industrial Science and Technology, Tsukuba, Ibaraki, 305-8569, Japan

ABSTRACT

Understanding the mechanical behaviors of carbon dioxide/methane hydrate-bearing sediments is essential for assessing the feasibility of CO₂ displacement recovery methods to produce methane from hydrate reservoirs. In this study, a series of drained triaxial compression tests were conducted on synthetic carbon dioxide hydrate-bearing sediments under various conditions. A comparative analysis was also made between carbon dioxide and methane hydrate-bearing sediments. The stress-strain curves, shear strength, and the effects of hydrate saturation, effective confining stress, and temperature on the mechanical behaviors were investigated. Our experimental results indicate that the newly formed carbon dioxide hydrate would keep the reservoir mechanically stable when CH₄-CO₂ gas exchange took place in a relatively short period of time and spatially well distributed in the pore space. Experiments of CO₂ injection in methane hydrate-bearing sediments are necessary to confirm this hypothesis.

Keywords: Carbon dioxide hydrate, mechanical behavior, CH₄-CO₂ replacement technology, triaxial tests