Geophysical Research Abstracts
Vol. 14, EGU2012-13354, 2012
EGU General Assembly 2012

Possibility of unlimited shear displacement due to sliding-surface-liquefaction of MH gasification and long runout submarine landslides

A. Tsukui (1), H. Fukuoka (2), and S. Yamasaki (3)

(1) Graduate School of Science, Kyoto University (tsukui@landslide.dpri.kyoto-u.ac.jp), (2) Research Center on Landslides, Disaster Prevention Research Institute, Kyoto University (fukuoka@scl.kyoto-u.ac.jp), (3) Kitami Institute of Technology (yamasaki@mail.kitami-it.ac.jp)

Recent studies on the mechanism of occurrence of large scale submarine landslides focuses mostly on the generation of excess pore pressure due to rapid sedimentation rate in certain environment, rather than gasification of methane hydrates (MH), although MH gasification could contribute to the landslides in the transgresssion period. However, at the 1896 Meiji Sanriku-oki Earthquake which caused serious tsunami disaster in the Tohoku region of Japan, there are witnesses of large-scale flame which were of possibly ejected dissolved methane hydrates (MH) from sea floor.
We employed the stress-controlled undrained ring shear apparatuses have been developed at Disaster Prevention Research Institute, Kyoto University to reproduce shear behavior of the dry sand-dry ice mixture under constant normal stress and shear speed control tests using the latest ring shear apparatus. Tested sample was mixture of silica sands and dry-ice pellets (frozen carbon-dioxide). Those mixtures are often used for studying the mechanism of the methane hydrates in laboratories because no explosion protection facility is required. Through three series of tests, we obtained following results.
(1) Rate Effect: The samples were tested under stepped shear speed ranging from 0.02 cm/s to 10 cm/s. The obtained excess pore-pressure ratio relationship, which is defined as the ratio of excess pore air pressure to initial effective stress, These results clearly shows positive speed dependency, especially for 1 cm/s and 10 cm/s. This phenomenon could be explained by the "sliding surface liquefaction."
(2) Difference between internal and external friction: Based on the published observation of the sliding surface and the BSR, the sliding surface can be generated in the boundary of the MH layer. Tests to compare the internal friction and external friction between sand layers reveals that the behaviour of the both conditions have no significant difference.
(3) Shear behaviour under cyclic loading condition: Above-mentioned sliding-surface-liquefaction in the sand - dry ice mixture supports the possibility of similar accelerating and unlimited displacement in the sand-MH mixture or boundaries between MH and sand layer induced by certain strong ground motion under sea floor. To simulate the earthquake-induced submarine landslides due to gasification of MH, authors applied the simple sine-curve cyclic loading to the sand-dry ice sample. After certain number of cyclic loading, sliding surface liquefaction appeared. When the mobilized shear resistance reduced by such excess pore pressure becomes smaller than the shear stress, accelerating behavior and unlimited shear displacement could be expected. Thus, MH still has high possibility to cause gigantic submarine landslides under certain strong earthquake condition.