Deformation and perturbation of Murono mud volcano (Tokamachi City, Niigata Prefecture, central Japan), triggered by the 2014 Kamishiro Fault Earthquake

*Yoshihiro Kakizaki[1], Glen Snyder[1], Manabu Tanahashi[1], Naoto Ishida[2], Ryo Matsumoto[2]

1. Gas Hydrate Research Laboratory, Organization for the Strategic Coordination of Research and Intellectual Properties, Meiji University, 2. Department of Social Systems and Civil Engineering, Graduate School of Engineering, Tottori University

Dissolved gas concentrations, compositions, and carbon isotopic values are compared between times immediately prior to and following the 2014 Kamishiro Fault Earthquake at the Murono mud volcano (Tokamachi City, Niigata Prefecture, central Japan). Immediately following the earthquake, concentrations of methane, carbon dioxide, ethane, and propane increased, while carbon isotopic values of methane and ethane decreased, on average. Carbon isotopic values of methane and gas compositions ($C_1/[C_2+C_3]$ ratio) indicate that the dissolved methane of the mud volcano originates from the thermogenic decomposition of organic matter. As the carbon isotopic values of methane and ethane are significantly more positive than those of natural gas from the Niigata Oil and Gas Field, the dissolved gases of the mud volcano are thought to be derived from the deepest source rocks of the Niigata Oil and Gas Field. Our results reveal that a change in behavior of dissolved gas at the mud volcano was likely triggered by fluctuations in volumetric strain related to the earthquake. Theoretical strain at the mud volcano can be estimated as 687×10^{-8}, which is much higher than the lower limit of earthquake strain at which mud volcanoes undergo heightened activities in previous studies. Murono mud volcano is an important case study for investigating the correlation between mud volcanoes and earthquakes, because it frequently experiences the large volumetric strain of earthquakes that are comparable to the 2014 Kamishiro Fault Earthquake.

Keywords: mud volcano, 2014 Kamishiro Fault Earthquake, dissolved gas, volumetric strain fluctuation, Niigata Oil and Gas Field, northern Fossa Magna region

