Geophysical Research Abstracts
Vol. 20, EGU2018-13844-1, 2018
EGU General Assembly 2018

AVO Analysis to Gas Hydrates BSR in the Continental Shelf of Canadian Beaufort Sea

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Gas hydrates are ice-crystalline solid containing gas molecules entrapped within rigid cage of water molecule (Sloan, 1998). Gas hydrates can be existed in the permafrost area on the polar region or marine environments under low temperature (<15˚) and high pressure condition (>5MPa) known as the gas hydrate stability zone (GHSZ. Gas hydrates are getting attention as a potential energy resource, but it is recognized for influence of global climate change and geohazard to seafloor.
In 2014, expedition ARA05C using Korean ice breaker RV ARAON carried out in collaboration with the Korea Polar Research Institute (KOPRI), Geological Survey of Canada (GSC), Monterey Bay Aquarium Research Institute (MBARI), and Bremen University (BARUM). This expedition was conducted to understand degrading permafrost and gas hydrates, fluid flow and degassing, seismic stratigraphy, and associated geohazards of the Beaufort shelf and slope region. During the expedition, we acquired the multi-channel seismic data (MCS) using the 8-array air-gun and 120 channels streamer (1.5 km). A total of 998 L-km MCS data with 19,962 shots were obtained along 23 lines. Riedel et al. (2017) identified for the first time the bottom simulating reflector (BSR), which is a gas hydrate-related seismic event, in the study area.
AVO analysis is very useful geophysical techniques used to determine the rock properties in onshore and offshore oil and gas exploration (Tinivella et al. 2008). In many studies, AVO analysis have shown good results in identification effect of gas hydrates and free gas (Wood et al., 2008). In this study, we conducted the Amplitude versus Offset(AVO) analysis and seismic inversion to examine detailed properties from the BSR occurred in the study area. Our study is aimed 1) to identify the gas hydrates and free gas distribution, 2) to estimate the rock properties for investigation of GHSZ, 3) to show AVO characteristics of gas hydrates and free gas. For AVO analysis, we conducted the gradient analysis, AVO attribute inversion, cross-plotting, and attribute volume calculation. P-wave velocity model and acoustic impedance model were reconstructed by sparse spike inversion. Our inversion results show existence of the low velocity zone by free gas, and its distribution.

Reference

Riedel, M., Brent, T. A., Taylor, G., Taylor, A. E., Hong, J.-K., Jin, Y.-K., and Dallimore, S. R., (2017), Evidence for gas hydrate occurrences in the Canadian Arctic Beaufort Sea within permafrost-associated shelf and deep-water marine environments, Mar. Petrol. Geol, 81, p.66-78.