IDENTIFICATION OF SUBSEA-PERMAFROST-DISTRIBUTION ON THE CONTINENTAL SHELF OF THE CANADIAN BEAUFORT SEA USING A FULL WAVEFORM INVERSION ALGORITHM

Seung-Goo Kang

Seung-Goo Kang[1], Jong Kuk Hong[1], Mathieu J Duchesne[2], Ugeun Jang[1], Sookwan Kim[1], Michael Riedel[3], Scott R. Dallimore[4], Charles K. Paull[5], Changsoo Shin[6], Hyojoon Jin[6] and Yong Keun Jin[1]*

[1]*Korea Polar Research Institute, Incheon, Republic of Korea.*
[2]*Geological Survey of Canada-Pacific, Quebec, Canada.*
[3]*GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany.*
[4]*Geological Survey of Canada-Pacific, Sidney, British Columbia, Canada.*
[5]*Monterey Bay Aquarium Research Institute, Moss Landing, California, USA.*
[6]*Seoul National University, Seoul, Republic of Korea.*

ksg9322@kopri.re.kr

ABSTRACT

Since the Last Glacial Maximum (~19 ka), Arctic permafrost regions have been flooded because of the inundation of the coastal area caused by sea-level rise, and submerged permafrost has since been melting. Previously, geophysicists have conducted research on the distribution of subsea permafrost across the Arctic continental shelf mainly using seismic refraction methods. However, this resulted in only limited understanding of the distribution depth including top-and bottom-bounds, shapes, and thawing patterns of subsea permafrost. Seismic P-wave velocity is the important geophysical parameters to distinguish permafrost with with ice-bearing sediments to normal coarse-grained sediment, and has been widely used to identify the distribution of subsea permafrost. Recently, two-dimensional full waveform inversion (FWI) method based on two-dimensional wave equation has been used to construct a P-wave velocity model from multichannel seismic data. FWI is known to extract quantitative geophysical parameters such as P-wave velocity from observed seismic data using wave propagation modeling and numerical optimization techniques. It can provide an accurate seismic velocity model even in case of extreme situations such as steep dipping layers or variable geophysical properties. In order to estimate the spartial distribution of subsea permafrost, we construct two-dimensional P-wave velocity models for the continental shelf in the Canadian Beaufort Sea using a waveform inversion method applied to seismic data acquired during expedition ARA05C. The results allow defining the top and bottom of subsea permafrost based on the variation of the obtained P-wave velocity structure. Our resulting P-wave velocity models are in good agreement with the existing distribution map of subsea permafrost from previous seismic refraction-analysis, regional geothermal models and detailed results of well-logging data analysis across the continental shelf of the Canadian Beaufort Sea.