Experimental study on imaging dissociation process of methane hydrate-bearing sediments by seismic tomography

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It is important to understand the dissociation process of methane hydrate-bearing sediments in order to develop an effective production technique of methane hydrate. The authors have been studying imaging techniques for dissociation processes by numerical and model experiments. Since the seismic velocity changes during dissociation process, seismic tomography was decided to be used for the purpose.

First, we conducted numerical experiments considering actual geometry of the model, in which we decided various model parameters, e.g. thickness of the methane hydrate-bearing sediments, width of the dissociated area, and velocity of each part of the model.

Then, we made a layered model by some kinds of gypsum and conducted seismic tomography measurements using ultrasonic transducers. As the results, first, a high velocity layer simulating methane hydrate-bearing layer was detected as high velocity. The low velocity area expanding in the high velocity layer was also detected by seismic tomography though the velocity value was not accurately reconstructed. In order to clarify the area of velocity reduction, it is useful to generate a velocity difference tomogram from the velocity tomograms obtained by both before and after dissociation. Unfortunately, the background low velocity layers of our models did not show the identical velocity distributions for those two cases.

Although it was difficult to figure out accurate velocity distribution by the seismic tomography, observed seismic waveform records showed obvious differences between before and after dissociation. Further studies are needed to determine more accurate velocity distribution or dissociation front during the dissociation processes of methane hydrate-bearing sediments.