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Comparison of in situ and laboratory acoustic property for various seafloor sediments in the East Sea, Korea

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Experimental data on in situ and laboratory sound velocity of various sediments were compared with a theoretical model in this study. We conducted geoacoustic exploration using upgraded KISAP (In situ geoacoustic measurement tool developed in 2015) in three areas of the East Sea: South Korea Plateau, Southeastern Inner Shelf, Ulleung Basin (hereafter, described SKP, SE, and UB area, respectively). Based on the seismic data, in situ acoustic data and sediment cores were simultaneously acquired on 7 stations to compare in situ and laboratory sound velocities. The in situ sound velocity was determined and laboratory ultrasonic sound velocity was measured by the pulse transmission technique. Sediment texture and physical properties (porosity, water content, and bulk density) analyses were additionally carried out. The laboratory sound velocity was corrected to in situ conditions for temperature and pressure with water depth. Comparisons of sound velocities between the in situ and laboratory in the clastic and volcaniclastic sediments of SKP area appeared differences of about 50∼60 m/s. The sound velocity of the sediment in the SE area characterized by gassy and homogeneous fine-grained sediments (mainly mud) was significantly lower in situ than in the laboratory. Meanwhile, the in situ sound velocities of the core from the seismic chimney site of UB area were significantly higher than in the laboratory, on a maximum by approximately 200 m/s. We attributed the difference of sound velocities to the presence of free gas in the sediments of SE area and to influence of gas hydrates under in situ conditions in the UB area. In the comparison of the experimental data with the theoretical model, the velocities of the sediments of the SKP area well fell within the predicted range, but the in situ velocities in the SE and UB area are out of the prediction range. This indicates that the difference between in situ and laboratory velocity is due to the difference of the frequency, but also that the in situ sound velocity is affected by the sedimentary environment of the in situ site as well as the physical properties of the sediments.