Exploration of ice deposits on the Moon using continuous seismic source system

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We have been designing and developing an active seismic exploration package with seismometers, active seismic source and anchoring system. Our seismic exploration package was designed to investigate from shallow formation (i.e., ice saturation) to deep formation (i.e., thickness of regolith) of the Moon. Here we present the basic concept of our seismic exploration package and its experimental results. We then discuss the possibilities of future space missions. We evaluate the relation between the S-wave velocity and the ice saturation, and found that S-wave velocity largely increase due to ice deposition (low ice saturation). To evaluate our active-source seismic exploration system, furthermore, we conducted seismic exploration in the test field in JAXA. The test field is filled with loose sands of ~50cm thickness. In this experiment, we conducted seismic survey with several acquisition parameters. When we applied the active seismic survey for small-size receiver array, we retrieved clear shot gather. We further calculated dispersion curve from the shot gather and obtained S-wave velocity profile beneath the array using inversion. In addition, we could detect the cushioning material whose S wave velocity is lower than sand by surface wave analysis and compare the result with the dispersion curve which has no buried material. These results demonstrate that S-wave velocity in shallow formation was accurately estimated, suggesting that ice can be identified as anomalous high S-wave velocity via our seismic system. When the seismometer interval is long, the attenuation of the surface wave is large. However, the refracted P-wave can arrive at far offset receivers. Using the refracted wave, we can estimate P-wave velocity of the basement.

