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Vertical Cable Seismic Survey for SMS exploration

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The Vertical Cable Seismic (VCS) survey is one of the reflection seismic methods. It uses hydrophone arrays vertically moored from the seafloor to record acoustic waves generated by sea-surface, deep-towed or ocean bottom sources. Analyzing the reflections from the sub-seabed, we could look into the subsurface structure. Because the VCS is an efficient high-resolution 3D seismic survey method for a spatially-bounded area, we proposed it for the SMS survey tool development program that the Ministry of Education, Culture, Sports, Science and Technology (MEXT) started in 2009. We have been developing the VCS survey system, including not only data acquisition hardware but data processing and analysis technique.
We carried out several VCS surveys combining with surface towed source, deep towed source and ocean bottom source. The water depths of these surveys are from 100m up to 2100 m. Through these experiments, our VCS data acquisition system has been also completed. But the data processing techniques are still on the way.
One of the most critical issues is the positioning in the water. The uncertainty in the positions of the source and of the hydrophones in water degraded the quality of subsurface image. GPS navigation system is available on sea surface, but in case of deep-towed source or ocean bottom source, the accuracy of shot position with SSBL/USBL is not sufficient for the very high-resolution imaging. We have developed a new approach to determine the positions in water using the travel time data from the source to VCS hydrophones.
In 2013, we have carried out the second VCS survey using the surface-towed high-voltage sparker and ocean bottom source in the Izena Cauldron, which is one of the most promising SMS areas around Japan. The positions of ocean bottom source estimated by this method are consistent with the VCS field records. The VCS data with the sparker have been processed with 3D PSTM. It gives the very high resolution 3D volume deeper than two hundred meters. Our VCS system has been demonstrated as a promising survey tool for the SMS exploration.