

High-resolution 3-D seismic survey (HR3D) of gas chimney structures off Joetsu, Niigata Prefecture

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In the summer of 2015, a high resolution three-dimensional seismic survey (HR3D) was carried out off Joetsu, Niigata Prefecture, to delineate the detailed structure of the gas chimneys which are widely distributed in the area off Joetsu.

In the sections of sub-bottom profiler (SBP), the gas chimneys are characterized by blanking which makes the inner structure of the chimneys invisible. This could be caused by high reflectivity materials existing in shallow layers near the sea floor and the seismic energy could not penetrate to deeper layers. This brings difficulties in tracking of the shallow gas hydrates and BSR as well as formation boundaries in the gas chimneys.

To image the detailed three-dimensional structure within the gas chimneys and its surrounding areas, an HR3D was planned and conducted with short streamer cables with high-density shot and receiver intervals along with high frequency airgun (GI Gun.)

The results of HR3D is good enough to reveal the fine structure in the gas chimneys which are unclear in the SBP data, even though the resolution is inferior to the SBP. The resolution of HR3D data is much higher than that of the existing large-scale 3D surveys which were carried out for petroleum exploration, even though the penetration is not enough compared to the existing 3D in this area.

The HR3D data, along with loggings and other geological data, will be a very useful tool to investigate the spatial distribution of gas hydrates which were confirmed at the wells drilled on the mounds and in the pockmarks.

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Keywords: high-resolution 3D seismic survey, HR3D, shallow gas hydrate, gas chimney, off Joetsu