An Integrated Study on the Gas Hydrate Area of Umitaka Spur, Joetsu Basin, Eastern Margin of Japan Sea, using Geophysical, Geological and Geochemical Data

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ABSTRACT

This study has two approaches: one is a structural-stratigraphic to investigate the geologic background of the formation of shallow gas hydrates. The other is a geochemical aspect to constrain the mechanism of gas migration and accumulation to form gas hydrate in shallow horizons. Discussion on the structural-stratigraphic control on the gas hydrates of Umitaka Spur is based on 2D single channel seismic (SCS) profiles. Geochemical discussion is based on the analysis of sediments collected by piston- and push-cores. The SCS study recognized chimney-like structures which seem to be strongly controlled by a complex anticline axial fault system. SCS profiles exhibit high amplitude events with pull-up structures, probably due to massive and dense accumulation of gas hydrate above. BSRs are widely developed, in particular, within gas chimneys and in the eastern flank of Umitaka Spur. The anticline axial fault system, the convex shape of the spur, and permeable layers as conduits induce gas migration to the top of the spur, providing strong seepages and giant plumes in the sea water column.

Geochemistry of sediments enabled the characterization of the background signatures and the origin of the organic matter of the Holocene and LGM sediments, on the basis of δ^{13}C_{org}, TOC/TN and TS/TOC ratios. The geochemistry of surface sediments at seep sites should be identical to the equivalent surrounding Holocene sediments. However, the geochemical signatures of the seep site sediments are similar to those of the deeper LGM sediments. Anomalous features of seep sites sediments seem to imply migration of sediments as well as water and gas. Deep-seated sediments were migrated upward from deeper horizons to the top of mounds, showing appearance older and deeper LGM sediments on the seafloor. The formation of gas hydrates at shallow zones cause an increase in the sedimentary volume inducing the formation of mounds.

Keywords: gas hydrates, single channel seismic, Umitaka Spur, Japan Sea

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