Variation of foraminiferal assemblage and C and O isotopic composition in the methane seep area off Naoetsu

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Introduction:

Umitaka spur 40 km off Naoetsu, eastern margin of Japan Sea, is characterized by large pockmarks, mounds and gas hydrate BSRs. Prominent gas plumes were identified on the spur during the Umitaka-maru cruises in 2004/2005. Interstitial water geochemistry suggest that the methane flux on the spur is 10 times as much as those on the Blake Ridge and Nankai Trogh. Moreover, massive gas hydrates have been recovered from the seafloor of the spur (Matsumoto et al., 2005). Natsushima-Hyper Dolphin cruise/dives have revealed gas hydrates, bacterial mats, and carbonate crusts on the seafloor. On the other hand, methane concentration of the seawater over the spur has been observed to be several to few thousands as high as normal offshore seawaters. Sediments and interstitial water chemistry also suggest large scale precipitation and dissociation of gas hydrates. With an intention to extract spikes of environmental impact of gas hydrate and methane seeps, we conducted studies on (1) foraminifer assemblage analysis, (2) carbon-14 age determination, and (3) carbon and oxygen isotopic analysis of benthic foraminifers in three piston cores which were recovered during KY06-08 cruise in 2005.

Sediments and depositional environments:

PC01 recovered 7 m long sediment core, which were dated as 20000BP at 3.9 m, and 25000BP at 6.4 m. Sedimentation rate is 0.2m/ky for the upper half and 0.4m/ky for the lower part. The sediments are composed of bioturbated massive units (0-1.5m, 3.6-4.6m,5.9-7.0m) and laminated units (1.5-3.6m, 4.6-5.9m).

Benthic foraminifer:

Sediment samples were sieved through 200 mesh. About 250 species have been identified but only 24 species occupy more than 3% at any point. Stainforthia rotundata, which is characteristic to methane dominant environments, occurs between 5.2 and 4.0 m. This implies that Methane activity was enhanced for the period of 25000BP to 20000BP.

Carbon and oxygen isotopic anomalies:

Seven species, Anglogerina kokozuraensis, Globobulimina auriculata, Valvurineria sadonica, Nonionellina labradorica, Pullenia apertura, Uvigerina akitaensis, Cassidulina japonica were selected for isotopic analysis to cover the entire depth range. For the lower part, carbon isotopic composition of G. auricurata and V. sadonica decrease from 6.5 to 4.0 m. This anomaly is likely to have been caused by methane seep and related phenomena. For the upper part, the carbon isotopic composition of these foraminifers range in narrow zone between -1 and -2 permil. Oxygen isotopic composition also shows decreasing pattern from 6.5m to 4.0m. Oxygen isotopic shift for the lower part could be explained as the results of temperature increase and/or oxygen shift of seawaters. However, considering the age of the phenomena (˜25000BP), negative shift of seawater oxygen and temperature increase are not likely to occur at the LGM. Enhanced methane seeps during the LGM seem to suggest that deep-seated, methane enriched, warm fluids were responsible for the oxygen and carbon shifts. However stadial-interstadial events during glacial period may have caused dissociation of gas hydrates (Kennett et al., 2002). More data and surveys are needed for the fuller understanding of the mechanism and impact of methane induced environmental changes in Japan Sea.