

Lateral variations of lagoon environment controlled by incised-valley geometry; An example from Holocene in the Niigata Plain

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[Introduction] The latest Pleistocene-Holocene sediments in the Niigata Plain are, when compared to other plains in Japan, composed of remarkably thick sediments that filled incised-valley formed by fluvial excavation during the low sea level of the Last Glacial, which allows high-resolution paleoenvironmental reconstruction. This particular setting was established due to active tectonics in the back-arc side of the Japanese Islands, and to the Shinano and Agano rivers that supplied a substantial amount of clastics.

[Materials and methods] This study used two boring-cores (KJSN, Kajikawa area; SRSN, Shirone area) drilled in the Niigata Plain in 2002 and elucidated sedimentary environments on the basis of facies and total organic carbon (TOC) and total sulfur (TS) contents (Yoshida et al, 2003). This study also tried to elucidate the three-dimensional environmental changes of water masses (subsurface and bottom) by combining with paleoecological data of the previous diatom studies.

[Lateral environmental variations] The lagoon sediments in the KJSN core consist of well-laminated mud, which indicates that benthic biogenic activities were limited due to an anoxic bottom environment. High TOC content in the sediments also suggests an anoxic bottom environment that was suitable for the preservation of organic matter. High TS content in them indicates a high-saline anoxic bottom environment where sulfate was dissolved and reduced by bacteria. In addition, previous diatom study elucidated a low salinity environment in surface water on the basis of plankton species (Yasui et al., 2002). These results suggest that the lagoon sediments in the Kajikawa area were deposited under an environment with high-saline, anoxic bottom condition as well as with low-saline surface water where a stable halocline readily developed.

On the other hand, the lagoon sediments in the SRSN core consist of heavily bioturbated mud, which indicates that primary sedimentary structures were largely destroyed by benthic biogenic activities in an oxic bottom environment. Low TOC content in them also suggests an oxic bottom environment that was not suitable for the preservation of organic matter. The previous diatom study elucidated a high-saline bottom environment. These results suggest that the lagoon sediments in the Shirone area were deposited under an environment with effective vertical circulation where oxygen supply to the bottom was sufficient for benthic organic activities. The oxic bottom environment should not have been suitable for pyrite formation as indicated by the low TS content in the sediments.

[Controlling factors on the variations] Recent studies have showed that the basement geometry of the alluvium is contrasting between the northern and southern parts in the Niigata plain.

Takahama and Urabe (2002) reported a gravel mound as the basement of the alluvium in the west of the Kajikawa area, which continues down south to the Niigata Higashi port along the coastline. This suggests a complicated basement geometry such as estuary in the northern part of the Niigata plain, which means a closed topography in the Kajikawa area even before barriers were formed. This should have limited the vertical and lateral circulations within the lagoon, which resulted in a stable halocline.

According to the previous studies, the basement geometry in the Shirone area is broad and flat and opens seaward, which should have allowed active water exchange with open seawater as well as vertical and lateral circulation within the basin. This is concordant with the highly saline and oxic bottom environment inferred by the present study.

These results as a whole suggest that the incised-valley geometry should be the fundamental factors controlling the lateral environmental variations of lagoon sediments.