Effect of environmental changes on origin and composition of organic matter, examples from the Pleistocene Choshi Core

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In land-ocean boundary area, such as shelf and continental slope environments, not only marine organic matter but also terrigenous organic matter is deposited. We examined the relationship between the environmental changes in the Choshi area and sedimentation of organic matter.

The Ocean Research Institute of the University of Tokyo drilled the Pleistocene sediments at the Choshi City in the northeast part of the Boso peninsula in 1997. The sediments were cored 250m below surface. The sediments of the Choshi Core were deposited in the forearc basin margin. We checked sedimentary facies and ichnofacies of the core and measured grain-size for sedimentary environmental analysis. Total organic carbon(TOC) and total nitrogen(TN) contents, and stable carbon isotope values of organic matter were measured. We estimate origin of organic matter with visual kerogen and stable carbon isotope analyses.

Sediments are composed of silt and sandy silt. Sedimentary structures, which are formed under tidal current and wave, are not recognized. Discrete burrows, which are associated with the Cruziana ichnofacies in shoreface to offshore environments and Zoophycos ichnofacies in areas below storm wave base, are found. These evidences suggest that the Choshi Core sediments are formed on the outer shelf. And the upward-coarsening facies succession is considered to indicate shallowing-upward in outer shelf environment.

TOC contents and C/N ratios range from 0.26 to 1.08% and from 5.90 to 9.45, respectively. The high peaks of TOC content coincide with high peaks of C/N ratio. Kerogen is mainly composed of NFA(non-fluorescent amorphous organic matter) and vitrinite with low contents of cutinite, WFA(weakly fluorescent amorphous organic matter) and alginite. Organic matter exhibits stable carbon isotope values between -21.6 and -24.6 permil. These results suggest that organic matter in the Choshi Core sediments is both marine and terrestrial origin.

Two variation patterns of grain-size and TOC content, and stable carbon isotope values are recognized in the Choshi Core sediments. One is below 85m in depth, called Mode A. Another is above 85m in depth, called Mode B. The horizon of 85m in depth is estimated about 500k.y. ago based on the age models by Okada et al.(2004). Mode A is characterized by high amplitude variation of TOC contents and depressive pattern of stable carbon isotope values. The horizons of high and low peaks of TOC content agree well with that of high and low peaks of C/N ratio, respectively. These results indicate that terrigenous organic matter affect on TOC content, although preserved organic matter include both marine and terrigenous origin. The phenomenon might be caused by inflows of turbidity currents in the central part of the basin at lowstand stage. Mode B is characterized by decrease of TOC contents and stable carbon isotope values, and coarsening of grain-size with shallower depth of the core. C/N ratios are higher than those of Mode A. These results indicate that the proportion of terrigenous organic matter in the sediments of Mode B is larger than that of Mode A. TOC contents show upward decrease with increase of C/N ratio and vitrinite proportion. Grain-sizes increase at the same interval. These results suggest that the increase of terrigenous materials is composed of both organic matter and inorganic particles. We infer that coarse-grained materials in the Choshi area are increased with shallowing of the basin. The central part of the basin in the Boso area had been filled with the turbidite and the environment were changed from the submarine-fan to shelf in the middle Pleistocene (Ito,1992).

The differences between Mode A and Mode B are the contribution of terrigenous materials, including organic and inorganic particles, with shallowing in the shelf. We infer that the change occurred at about 500k.y. ago, when the depression of the basin in the Boso Peninsula had been filled by turbidite.