

Origin of amorphous organic matter and its application to paleoenvironmental analysis

Akiko Omura[1], Koichi Hoyanagi[2]

[1] Shinshu Univ., [2] Geology, Shinshu Univ.

Particulate organic matter (kerogen) constitute at more than 90 percents of total sedimentary organic matter (Tissot and Welte, 1984) and contain amorphous organic matter. Amorphous organic matter does not have definite morphological characters and is not subdivided by transmitted light microscopy. Therefore, amorphous organic matter has not been used for paleoenvironmental analysis. Amorphous organic matter has been mainly considered to be marine origin (Tissot and Welte, 1978) and recently both marine and terrestrial origin (Masran and Pocock, 1981 ; Venkatachala, 1981 ; Suzuki, 1984). Sawada and Akiyama (1994) stated that fluorescent, non-fluorescent and weakly fluorescent amorphous organic matter are of pollen and spore, vitrinite and land plants, and marine plankton origin, respectively on the basis of fluorescent character and stable carbon isotope compositions. Gorin et al. (2001) suggested that non-fluorescent amorphous organic matter is formed under the anoxic environment by bacterial activity, since high non-fluorescent amorphous organic matter contents are recognized in the ocean anoxic event (OAE) and also bacteria are recognized on the non-fluorescent amorphous organic matter by an electron microscope. The purpose of this study is decision of origin of amorphous organic matter and its application to paleoenvironmental analysis.

Stable carbon isotope composition is strongly influenced by relative contribution of terrestrial- and marine-derived organic materials to the sediments (Nakai et al., 1982 ; Bird et al., 1994) and stable carbon isotope compositions of terrestrial origin are different from that of marine origin (e.g. Chung et al., 1992 ; Jasper and Gagosian, 1990). The Neogene to Holocene sediments on the coastal to basin floor environment and the surface sediments of Lake Kizaki in this study contain NFA and WFA. Stable carbon isotope ratios of two kinds of typical samples such as high NFA and high WFA were measured. Purified CO₂ of organic matter was analyzed for carbon isotope ratios on a Delta Plus mass spectrometer. The values of delta 13C are presented on the PDB scale, using a working standard compared to the PDB standard. Particulate sedimentary organic matter of the Pliocene sediments, and also of the surface sediments of Lake Kizaki and Holocene sediments of northern Japan basin composed mainly of NFA show delta 13C values between -24.6 and -27.6 permil. Particulate sedimentary organics matter of the Miocene and Pliocene sediments composed of mainly WFA (88 to 97%) show delta 13C values between -20.0 and -23.6 permil. Samples of high NFA content and high WFA content show delta 13C values of terrestrial origin and marine origin, respectively. It is concluded that NFA and WFA are originated from terrigenous and marine organic matter, respectively.

The maximum flooding surfaces set up in the shelf sediments in the Chuo Oil Field, the Kitakambara and the Nishikubiki districts were formed at the same maximum rising stage of sea-level at 3.5Ma. The maximum flooding surface is characterized by a high content of NFA in the three districts. High content of NFA indicate a suboxic sea floor environment. TOC content increases in a transgressive systems tract and shows the highest value just above the maximum flooding surface in the Nishikubiki district. Samples of transgressive and highstand systems tracts in the Nishikubiki district contain a total sulfur content of 0.38 to 1.26%. Sea floor of the shelf in the Nishikubiki district was under a reductive condition at the transgressive and highstand stages. It is concluded that the sea floor of shelf environment at the maximum flooding stage might be suboxic in the Niigata sedimentary basin. Our study revealed that amorphous organic matter ratio is one of the important indicators for oxic-anoxic conditions of sedimentary environments.