Late Pliocene paleoenvironmental changes in the paleo-Tosa Bay based on organic matter analysis of Ananai Formation drilling core

Shigetaka Kita[1]; Minoru Ikehara[2]; Yasuo Kondo[3]; Masao Iwai[4]

[1] Dept. Natural Environ. Sci., Kochi Univ.; [2] Center Adv. Marine Core Res., Kochi Univ.; [3] Earth History, Kochi Univ.; [4] Kochi Univ.

1. Introduction

The Ananai Formation is one of the Pliocene Tonohama Group, which is distributed in west coast of the Muroto Peninsula, Kochi. Kondo (2005) reported that there are several sedimentary cycles in the Tonohama Group. The base of the sedimentary cycle is granular shell bed, and then grain size become smaller by degrees from lower to middle part, smallest at middle part, and larger by degrees from middle to upper part. It was inferred that the sedimentary cycle were formed by sea-level change due to glacial-interglacial climate change. It was also considered that a maximum paleo water depth of the Ananai Foramtion deposition was estimated to about 100m, therefore these sediments were deposited on the continental shelf in the paleo-Tosa Bay. However, the paleoenvironmental changes recorded in the formation were remained poorly understood. In this study, we analyzed sedimentary organic matter of the Ananai Formation. We will consider the quantitative and qualitative evaluations of sedimentary organic matters. We also try to discuss the relationship between organic material cycle and sedimentary cycle.

2. Sample and method

The continental drilling core (ANA) was recovered from the Ananai Formation in Tonohama, Yasuda-town, Kochi, at early 2006. There was seventeen sedimentary cycles in the core, corresponding to that looked in the Ananai Formation. According to chronostratigraphic studies after the drilling, sedimentary age of the core was estimated to approximately 3Ma. Unfortunately, a complete age model of the core have not been established yet, because there was difference of time scale between biostratigraphy and magnetostratigraphy. We analyzed organic matter in the sediments using the following several methods such as elemental analysis, carbon analysis, and stable isotopic analyses. The dried samples were analyzed in elemental analyzer on-line mass spectrometer (DeltaPlus Advantage) to reveal the total organic carbon (TOC) coentents, total nitrogen (TN) contents, and carbon isotope ($d^{13}C_{org}$) of organic matter in the sedimentary cycle 12 to 14. Oxygen isotope ratio ($d^{18}O$) of foraminiferal test were also measured in the cycle 13 to evaluate the sea level change using the stable isotope mass spectrometer (IsoPrime).

3. Results and discussion

The $d^{18}O$ values of the benthic foraminifer *Cibicidoides wuellerstorfi* were increased at upper and lower parts, and decreased at middle part in the sedimentary cycle 13. The maximum amplitude of benthic $d^{18}O$ variation was calculated to 0.78 per mill. The benthic $d^{18}O$ change probably reflect the global sea-level change by continental ice volume change. It conform the low sea-level time suggested by the benthic $d^{18}O$ and the sedimentary cycle. Therefore, detailed benthic d18O recored showed that the sedimentary cycle in the Ananai Formation was originated from eustatic sea-level change due to glacial to interglacial climate change in the late Pliocene. Based on the $d^{18}O$ stratigraphy, sedimentation rates were estimated to about 14 cm/kyr.

The $d^{13}C_{org}$ of organic carbon was fluctuated from -25.1 per mill and -23.2 per mill with an averaging -23.9 per mill. Generally, the $d^{13}C_{org}$ value of terrestrial organic matter derive C_3 land plants are averaged to -27 per mill, the $d^{13}C_{org}$ value of marine organic matter produce in middle latitudes are averaged to -20 per mill (Tyson, 1995). Therefore, it is suggested that terrestrial organic matter is a little greater than marine origines. It is suggested that TOC% changes were depend on inputs of terrestrial organic carbon, according to the terrestrial and marine organic carbon calculated. There is a pattern of the terrestrial organic carbon concurred the sedimentary cycle. It is inferred that the terrestrial organic matter charge rate was changed by the distance change between land and Ananai formation when Ananai Formation deposited.