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Distribution of GDGTs within an anoxic water column and its TEX_{86} temperatures in the modern coastal sea

Kazuyoshi MORIYA[1*], Michinobu Kuwae[2], Masanobu Yamamoto[3], Tadao Kunihiro[4], Hidejiro Onishi[4], Naoki Fujii[4], Hideki Hamaoka[4], Kouji Omori[4], Takuya Sagawa[2], Mitsuyo Saito[4], Junya Shibata[4], Hidetaka Takeoka[4]

[1]Dep. Earth Sciences, Waseda Univ., [2]Senior Research Fellow Center, Ehime U.,
[3]Div. Earth System Sci. Hokkaido Univ., [4]CMES, Ehime Univ.

It is widely accepted that atmospheric carbon dioxide concentration is rapidly increasing in these 2 00 years. Mean air temperature have been increasing by the surplus global warming gasses. Although oceanic temperature increase has also been discussed at the open ocean, global worming effect at the Seto Inland Sea is still unidentified. Because systematic and precise instrumental sea surface temperature (SST) data for these 200 years are very scarce in the Seto Inland Sea, we need to employ a certain SST proxy. However, paleo-thermometry in the shallow coastal ocean seems to be quite difficult because adequate carbonate microfossils for paleo-temperature proxy would be absent in such shallow ocean. On the other hand, another candidate for paleo-thermometry would be an organic compound based paleo-temperature proxy, such as UK_{37}' or TEX_{86}. In this study we employ $TEX_{86}$for paleo-thermometry of the Seto Inland Sea. However, since TEX_{86}have never been systematically utilized in such shallow marine sediments, applicability of $TEX_{86}$is still uncertain in the coastal ocean.
Here we test potential ability of TEX_{86}paleo-thermometry in shallow coastal ocean. We collected particulate organic matters (POM) from water column of Beppu Bay at every 10 m deep including surface and depth showing chlorophyll maximum. Because depth of Beppu bay is 70 m deep, we totally collected 9 POM samples in a single expedition. Then vertical depth profile of glycerol dialkyl glycerol tetraethers (GTGTs) distribution within a water column was analyzed. We also calculated TEX_{86}value from GDGTs distribution, and those $TEX_{86}$was compared with in situ water temperature.

Coastal waters at Beppu Bay were sampled for POM at every 10 m deep on October and November 2008. Ten liters of water collected were filtered through pre-combusted glass fiber filters with a nominal pore size of 0.7 micrometer within one day after collection. Filters were ultrasonically extracted with dichloromethane and methanol (2:1 by volume) at Hokkaido University. GDGTs were analyzed by high performance liquid chromatography mass spectrometry at Hokkaido University.
Total GDGTs abundance within a water column shows a very peculiar distribution. Though total GDGTs abundance at shallower than 50 m deep are almost constant, total GDGTs are significantly increased at 60 and 70 m deep. Because Bappu Bay is isolated from Iyo-nada and other part of the Seto Inland Sea by submarine sills of 50 m deep, cold stagnant and anoxic water mass is developed at bottom of Beppu Bay. Since depth showing abrupt increase of total GDGTs is well correlated with the depth of oxic/anoxic boundary within a water column, it is assumed that GDGTs production is enhanced in the anoxic water mass. In fact, calculated TEX_{86}temperatures at 60 and 70 m deep are much cooler than those at shallower than 50 m deep. Moreover, those TEX_{86} derived temperatures show well consistency with in situ observed water temperatures at all depth. Therefore we believe that TEX_{86}record in situ water temperature at Beppu bay, although total GDGTs within POM are much higher in anoxic water mass than in the oxic water mass.

Keywords: Seto Inland Sea, Beppu Bay, anoxic water, Archaea, GDGT, TEX86