

A 100-year temperature record linked to decadal-scale variability of Kuroshio current based on benthic foraminiferal Mg/Ca

Michinobu Kuwae[1]; Yuichi Hayami[2]; Atsushi Kaneda[3]; Azumi Yamashita[4]; Hidetaka Takeoka[3]; Yoshio Inouchi[1]; hodaka kawahata[5]

[1] CMES, Ehime Univ.; [2] Civil and Environ. Engineer., Ehime Univ; [3] Center Mar. Environ. Studies, Ehime Univ; [4] Ehime Prefect. Fish. Experim. St.; [5] AIST

For understanding not only mechanisms of changes in coastal environments, ecosystems, and fishery resources in Japan coastal area, but also a basin-scale climate system of the North Pacific and their forecast, detecting characteristics of decadal-scale variability of Kuroshio current is very important. Although there are sedimentary record of Kuroshio current on the millennial timescale (Jian et al. 2000) and instrumental record on decadal timescale (Yasuda and Hanawa, 1997), records that focus on multidecadal to centennial variability are still fairly rare. Here we present a high-resolution temperature record from the Bungo Channel during the last 100 yr based on Mg/Ca ratios of benthic foraminifera tests, thereby attempting to reveal multidecadal-scale Kuroshio current variability.

In the Bungo Channel, it is known that there is a phenomenon that bottom temperature is lowered due to frequently bottom intrusions of cold water originated from Kuroshio region during the early to late summer. Recent hydrographic studies in a region between Kuroshio current and the Bungo Channel show that strength of the bottom intrusion is closely linked to variability of Kuroshio path or transport; when the Kuroshio path flows adjacent to the Bungo Channel or the transport is enhanced, bottom intrusions frequently occur accompanied by strong upwelling along the shelf slope, and vice versa. This relationship between Kuroshio path and strength of bottom intrusion in the Bungo Channel appears to have persisted during the last 30 years (Kaneda et al, 2002). If the relationship is steady phenomenon in this region, sedimentary records of the bottom temperature in the Bungo Channel is expected to reveal as indirect those of variability of Kuroshio current.

We measured benthic foraminiferal Mg/Ca ratios using core samples from Shitaba Bay which is located on the east margin of the Bungo Channel and attempted to reconstruct bottom temperatures. A record of reconstructed temperature in the Shitaba Bay during the last 100 years showed interannual through decadal-scale variability. The pattern in the reconstructed temperature record is similar to that of observational data, we, therefore, consider the benthic foraminiferal temperature record to be representative of bottom temperatures during the early to late summer.

The temperature record also showed a previously-unknown increased trend with 1.3 °C per 100 years in the Bungo Channel. We believe that the trend is related to anthropogenic global warming; a temperature anomaly record eliminating the trend represents the Kuroshio Current change because the reconstructed temperature record is closely correlated with that of observed bottom temperature which is fundamentally influenced by modulation of Kuroshio Current. Spectral analysis of the anomaly record showed periodicities centered at ~5 and ~50. The ~50 periodicity is found in the record of foraminiferal isotopes from the Santa Barbara Basin which probably represents California Current changes (Field and Baumgartner, 2000), and also found in the instrumental climatic record of the North Pacific with decadal-scale components such as the PDO or the NPI (Mantua et al, 1997; Minobe, 2000). Our temperature records during the last 100 years suggested a linkage of the Kuroshio Current variability and that of basin-scale climate of the North Pacific, as well as that of the California Current variability identified from sedimentary records in the Santa Barbara Basin. However, since the 100 year record presented here is insufficient for accurate determination of the ~50 yr periodicity, we must develop longer-term records of temperature in the Bungo Channel.