A snapshot of Holocene sea surface temperature variations reconstructed by oxygen isotope records of a fossil coral from Kikai-jima (Ryukyu Islands, Japan)

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The Holocene climate optimum (HCO) is one of the highlight events in the Quaternary research because of its importance of warming mechanism and its possible role in the rise and fall of the East Asia ancient society. There are already many previous paleoclimate studies on the continental East Asia by using cave records or lacustrine sediments, and foraminifera for the marine records. However, there is little research on high-resolution ocean-atmosphere variability at the sea surface in the Ryukyu Islands. It leads to the difficulty of what climate mechanism affects the marine environment in East Asia, while the other factors put influence on the inland. In this study, stable oxygen isotope records are measured using a 2.1m-long fossil coral collected from Kikai-jima, Ryukyu Islands, southwestern Japan, and reconstruct the sea surface temperature (SST) for a selected time window of ~200 years during the mid-Holocene. In addition, in order to avoid diagenetic alterations and possible geochemical contaminations on the fossil coral, we conduct X-ray diffraction analysis and scanning electron microscope observation, and show the fossil is pristine. Using previously published oxygen isotope-paleothemometers derived from modern corals in Kikai-jima, our result implies that the average SST at 4.7 ka is about 27-28˚C, which is ~2˚C higher compared with the modern value. Moreover, the SST in summer is estimated to be about 30-31˚C and 24˚C in winter at that time. The reconstructed SST suggests that a warmer environment in Kikai-jima during the mid-Holocene may result from the enhancing insolation, and it also indicates a stronger East Asia Monsoon (EAM) in summer and a weaker EAM in winter than the present.

Keywords: Paleoclimate, Holocene climate optimum, Sea surface temperature, Fossil Coral , Ryukyu Island, East Asian Monsoon

