

Skeletal records in sclerosponges from Miyako-jima, Ryukyu Islands

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Sclerosponges, living in dark environments of tropical to subtropical shallow oceans, precipitate calcium carbonate skeleton with growth bands. They grow slowly at an approximate rate of <1 mm/year unlike corals (about 1 cm/year) but can be so long-lived for several decades to hundred years like corals (e.g., Benavides and Druffel, 1986). Skeletal oxygen isotopic ratios ($\delta^{18}\text{O}$) reflect variations in sea surface temperature and seawater $\delta^{18}\text{O}$ with the latter being closely related to salinity reflecting the precipitation-evaporation balance at the sea surface and changes in water mass transport (e.g., Wu and Grottoli, 2009). In contrast to zooxanthellate corals, which commonly show positive correlations between skeletal $\delta^{18}\text{O}$ and carbon isotopic ratios ($\delta^{13}\text{C}$), there do not exist vital effects in the secretion of sclerosponge skeleton (Druffel and Benavides, 1986). Previous studies showed significant decrease trends in the $\delta^{13}\text{C}$ records toward the present, which is probably a result of $^{12}\text{CO}_2$ added into the atmosphere/ocean from fossil fuel burning (e.g., Bohm et al. 1996). Therefore, sclerosponges are shown to provide annually resolved time series of proxy records of ocean environments since the Industrial Revolution. However, longer (>100 year) proxy records from sclerosponges were derived only from the Atlantic Ocean.

Here we present $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ records from high-Mg calcite skeleton of two sclerosponges (*Acanthochaetetes wellsi*) collected at a water depth of about 10 m from Miyako-jima, Ryukyu Islands in the North Pacific. The samples were slabbed to a thickness of 5 mm parallel to the skeletal growth and subsamples for stable isotope measurements were taken every 1 mm. External precision of replicate measurements of interlaboratory calcite material throughout the stable isotope analysis using a continuous flow isotope ratio mass spectrometer system (Delta V Advantage and Gasbench II: Thermofisher Scientific Inc.) of Ryukyu University was ± 0.05 per mil for $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$. Soft X-ray images showed highly developed skeletal growth bands with >100 high/low density layers. The secular changes in $\delta^{13}\text{C}$ of the two sclerosponges were quite similar to previously reported $\delta^{13}\text{C}$ records from Atlantic and Pacific corals and sclerosponges. The long-term $\delta^{18}\text{O}$ trends of the two samples are characterized by slight depletions throughout their living periods, indicative of an overall trend toward warmer ocean environment around Miyako-jima. Our sclerosponge-based estimates of sea surface temperature and salinity may document thermal and hydrologic variations in the Ryukyu Islands, furthering a good understanding of northwestern tropical-subtropical Pacific climate change for the last several centuries in conjunction with coral-based long proxy records.

Keywords: sclerosponge, skeleton, oxygen isotope composition, carbon isotope composition, paleoenvironment, Ryukyu Islands