

Holocene climate records in coral reefs from the South China Sea

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Coral reefs, excellent climatic and environmental archives in tropical oceans, are widely distributed in the South China Sea (SCS), which is the largest enclosed marginal sea of western Pacific, covering over 20° in latitude and different climate conditions. Our recent research in the SCS focuses on coral-based high-resolution climate reconstruction and coral reef ecological responses using geochemical and U-series geochronological tools, which provide an ideal opportunity for understanding of Holocene climate processes and events. Some major research highlights are summarized below:

1. Proxies for sea surface temperature (SST) and salinity

Combined monthly-resolution coral skeletal $\delta^{18}\text{O}$, Sr/Ca and Mg/Ca records from SCS suggest that the Sr/Ca-SST relationship is a reliable thermometer, and the combination of coral Sr/Ca and $\delta^{18}\text{O}$ is a useful tool for constraining past SST and salinity. However, Mg/Ca is not a reliable proxy for SST although its annual cycles are well correlated with instrumental SST. Calculated Mg/Ca-SST values for the Holocene corals based on the empirical Mg/Ca-SST relationship derived from modern corals are unrealistically too low, which could be due to loss of Mg during preferential meteoric dissolution of cryptic Mg-calcite-bearing microbialites in the exposed fossil corals [1].

2. Mid-late Holocene SST and salinity change

Combined $\delta^{18}\text{O}$ and Sr/Ca records from 5 fossil corals revealed a general decreasing trend in SST and salinity in the SCS from ~6,800 to 1,500 years ago despite shorter climatic cycles, consistent with general weakening of the East Asian summer monsoon since early Holocene [2]. In contrast with this general cooling trend, SST increased dramatically in recent time, probably related to the increase of anthropogenic greenhouse gases.

3. Evidence for coral "cold bleaching" in mid-Holocene

SST in the SCS during the mid-Holocene was 0.9-0.5 °C higher than in 1990s. However, well-developed *Goniopora* reefs in northern SCS suggest at least nine severe winter cooling events occurred during 7.5-7.0 ka BP with cycles of 30 to 50 years, causing mass coral mortalities [3]. This is the first pre-historic evidence for cold-bleaching of reef corals.

References

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- [3] Yu K. F., Zhao J. X., *et al.* (2004) *EPSL* **224**, 143-155.