Decadal variability of seawater pH on coral reefs: Mechanism and influence on its long-term variations

GANGJIAN WEI[1], XUEFEI CHEN[1], TING KE[1], YING LIU[1], ZHIBING WANG[1], WENFENG DENG[1] AND TI ZENG[1]

[1]State key Laboratory of Isotope Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou, 510640, China gjwei@gig.ac.cn

Variations of seawater pH on coral reefs is very violent. The diurnal seawater pH variaiton is up to 0.5~0.6 U driven by photosynthesis and respiration of the biomass. Currently available seawater pH records covering the past several hundred years reconstructed from coral boron isotope generally exhibit marked decadal variability with annual variation up to 0.3~0.4 U. Its mechanism, as well as its influence on the long-term variation of seawater pH, however, has not been well known yet. We here present a 159-year's seawater pH records in annual time resolution reconstructed from the $\delta^{11}B$ of a *Porites* coral from the eastern Hainan Island in the northern South China Sea to investigate these issues. This region is largely influenced by an upwelling system driven by the East Asian summer monsson. The results indicate that significant decadal varibility with robust periodicities of ~18 years and ~5.6 years occurs in the seawater pH records. Such seawater pH variation correlate negatively to that of the sea surface temperature anomaly and the intensity of the East Asian summer monsoon, with higher pH corresponding to colder SST and stronger summer monsoon. This suggests that strong summer monsoon enhances the upwelling system, and brings more cold but nutrient-rich deep water. As a result, the productivity is improved, which consumes more dissolved inorganic carbon and increase seawater pH. It is therefore activities of biomass on coral reef may also an important factor to control seawater pH variation over decadal time scales.

A cross comparison of the coral-$\delta^{11}B$ based seawater pH records in the west Pacific indicates that decadal variability in different regions is different due to the different factors controlling the productivity, but the seawater pH decreasing trends over the past 200 years are similar. This suggests that the long-term seawater pH variation over the past several hundred years is driven by a general factor, the rapid increasing of atmospheric CO_2 by anthropogenic emission.