Possibility of quantitative reconstruction of past salinity change using stable isotope and trace element in coral skeleton

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The coral d180 reflects a combination of the SST and the d180 of seawater which is related to the salinity. On the other hand, the Mg/Ca ratio of coral skeleton reflects the SST independent from salinity. By using these relationships, it is possible to determine the past SST and SSS uniquely. To assess this hypothesis, we measured the Mg/Ca ratio and the d180 of coral core collected from Puerto Rico in the Caribbean. Also sea water d180 was measured at the coral site. The calculated SSS by using these was consistent with a precipitation spike at coral site. The d180 and Mg/Ca ratio of coral core during the Little Ice Age suggested that the SST during the LIA was approximately 2 degree cooler and the SSS showed greater seasonal changes than at present.

There are few proxies for quantitative reconstruction of past salinity change with seasonal time resolution, although is salinity is one of the most important climate variables. The oxygen isotope composition (d180) of coral skeleton reflects a combination of the sea surface temperature (SST) and the d18O of seawater which is related to the sea surface salinity (SSS). On the other hand, the magnesium/calcium (Mg/Ca) ratio of coral skeleton reflects the SST independent from salinity. By using these relationships among coral Mg/Ca ratio, coral d180, the d180 of seawater, and SST, it is possible to determine the past SST and SSS uniquely. To assess this hypothesis, we measured the Mg/Ca ratio and the d180 of modern part of a 3 m long coral core collected from the southwest coast of Puerto Rico in the Caribbean Sea where both SST and SSS changes. Also seawater d180 was measured at the coral site. The calculated SSS by using these equations agreed with the range of measured salinity and was consistent with a precipitation spike at coral site. After calibration, the reconstruction of the seasonal changes in SST and SSS during the Little Ice Age (LIA) in the Caribbean Sea was attempted. The d180 and Mg/Ca ratio of the coral skeleton between 1699 and 1703 suggested that the SST during the LIA was approximately 2 degree cooler and the SSS showed greater seasonal changes than at present. We also estimated the error excepted for this quantitative reconstruction by comparing two coral colonies at same site.