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Amplification of inferred temperature changes on interannual timescales - implications from a long-term calibration study of coral Sr/Ca and U/Ca using local temperatures

T. Felis (1), A. Suzuki (2), H. Kuhnert (1), H. Kawahata (3,2)

(1) DFG-Research Center for Ocean Margins (RCOM) & MARUM - Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany (tfelis@uni-bremen.de), (2) Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan, (3) Graduate School of Frontier Sciences & Ocean Research Institute, The University of Tokyo, Tokyo, Japan

One of the most important issues in coral paleoclimatology is the assessment of the robustness of the Sr/Ca and U/Ca paleothermometers. However, long-term calibration studies using in situ or local temperatures are still rare, especially for coral U/Ca. This has resulted in the common application of coral proxy-temperature relationships derived from seasonal calibrations to infer temperature changes on interannual and longer timescales with mixed results. Here we present results of a 20-year calibration study from a western subtropical North Pacific site using local temperatures. A core was drilled from a living Porites coral growing the north coast of Chichijima (Ogasawara Islands). The bimonthly resolved records of Sr/Ca and U/Ca generated from the aragonitic skeleton show clear annual cycles that reflect the sea surface temperature (SST) seasonality, which has an amplitude of 7 °C at Chichijima. Local SST used for calibration was measured at a nearby location since 1974.

The slopes of the equations derived from the regression of bimonthly coral Sr/Ca and U/Ca on local SST are similar to those of Porites calibrations at other locations. However, compared to bimonthly data, the regression slopes are different for annual average data. The annual regression slopes for Sr/Ca and U/Ca imply an apparent am-

plification of inferred SST variations on interannual and longer timescales. Such an apparent amplification is also evident in South Pacific coral Sr/Ca records. Differences in the slope relation between seasonal and annual regressions are most likely due to processes associated with coral physiology and calcification. Our findings could have important implications for the reconstruction of mean temperature conditions from fossil corals, where the application of a seasonal calibration could result in an overestimation of past changes in mean temperatures, e.g., during the last glacial maximum.