

DECADAL TIME SCALE TEMPERATURE CHANGE AS REVEALED BY
SCLEROCHRONOLOGY AND THE Sr/Ca THERMOMETER
IN *PORITES LOBATA* ACROSS THE HAWAIIAN ARCHIPELAGO

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ABSTRACT

Massive scleractinian corals deposit aragonitic skeletons which record the ambient temperature and chemistry of the seawater in which they grew. In this study *Porites lobata* were collected over a geographic range of 2000 km across the Hawaiian Archipelago, from Midway Atoll, French Frigate Shoals and Oahu. Physical characteristics, extension (growth) rate and excavation from boring organisms, and chemical characteristics, the ratio of Strontium to Calcium (Sr/Ca), were investigated. It was determined that coral extension in the Hawaiian Archipelago is limited by temperature and light, which are largely functions of latitude. At specific locations, such as the inside of Midway Atoll, colony age and size is further limited by bioerosion from the excavation activities of boring organisms, mostly sponges. Sr/Ca analysis and use of the Sr/Ca-SST equation $\text{Sr/Ca mmol/mol} = 11.36 - 0.0904T^{\circ\text{C}}$ provided 10 to 23 year temperature time-series from coral skeletons. It was found that SST recorded by corals decreases with increasing latitude with one notable exception: the corals growing on the inside of Midway Atoll recorded temperatures an average of 1.5 °C warmer than temperatures recorded by corals growing on the outside of the atoll. Due to difficulties in accurately dating coral samples, correlation with satellite data over the short term was relatively weak ($r^2 = 0.02 - 0.45$). However, the temperature records from corals show longer-term correlation with temperature data from satellites and single point samples. For example, from 1975-1995 a colony from Oahu showed a mean temperature of $25.23 \pm 2.2^{\circ\text{C}}$ (1σ), while temperatures measured from surface water temperature samples showed a mean temperature of $25.28 \pm 1.8^{\circ\text{C}}$ over the same time period. These long term records prove useful for revealing decadal scale climate trends. A colony analyzed

from Shark Island, French Frigate Shoals, recorded a mean temperature of 24.0 ± 1.7 °C from 1977-1988 and 25.8 ± 3.0 °C from 1988-1997. This colony may be recording the signal from the North Pacific Oscillation (NPO), which shifted in 1988 to a warmer background state from a cooler state in 1977-1987. There was a mean 0.6 °C increase from 1977-1995 recorded by both corals from Oahu. This increase may be the result of greenhouse warming and may be part of the 0.5 °C increase seen in global SST's during the 20th century. To detect shorter scale temperature records, it is necessary to sample at higher spatial resolution within the coral skeleton and match the Sr/Ca from these samples to events in the SST record.