THE POTENTIAL UTILIZATION OF SCLERACTINIAN CORALS IN THE STUDY OF MARINE ENVIRONMENTS

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ABSTRACT

The response of skeletal chemistry, linear growth and density-band formation in living scleractinian coral colonies was examined with respect to environmental conditions. Light intensity and water temperature were the primary parameters studied. The feasibility of using the skeletal properties of scleractinian corals for retrieval of paleoenvironmental information was the objective of this investigation.

Skeletal strontium content was found to be inversely related to temperature. Strontium is a crystal lattice substitute for calcium and is the most resistant to chemical alteration among the minor chemical constituents, consequently its concentration has the potential for use as a paleothermometer. Magnesium and sodium could not be correlated with any of the environmental variables studied; however, it was determined that sea salt inclusion was responsible for a portion of their skeletal content. To assess this random sea salt contamination, an analytical procedure was developed to measure chloride concentration. In addition, sulphate content was found to be higher in coral aragonite than could be accounted for by sea water evaporation. Sulphate may be useful in the study of diagenesis.

From the results of light attenuation experiments, it appeared that density-band formation in the corals *Cyphastrea ocellina* and *Porites compressa* was independent of seasonal changes in light intensity. The linear growth rates of these corals were nearly constant over the course of a year; hence density bands were due

to changes in calcification rates, not changes in linear growth rates. The temporal progression of band phase was closely monitored. Individuals of a species were in near synchrony; however, each species had a distinctly different pattern. When band sequence was compared with water temperature, solar radiation and photoperiod records it was apparent that no direct relationship existed. These observations suggest that species-specific physiological factors play an important role in band formation.

Skeletal structures and densities of coral colonies were examined by x-radiography. Species can be identified on the basis of their x-radiographs and a number of superficially similar *Porites* species were differentiated in this study. Additionally, the taxonomic identification of fossil fragments where surface features are missing can be accomplished by this technique.

The difference in growth rate, pigmentation and zooxanthellae content between *Montipora verrucosa* and *Pocillopora damicornis* colonies maintained in aquaria under a series of light conditions was examined. *Montipora verrucosa* showed a growth optimum at a lower light level than *Pocillopora damicornis* and grew well over a wider range of intensities. These differences can be attributed in part to the thick tissue layer of *Montipora verrucosa* which penetrates into its perforate skeleton in contrast to the thin veneer of living tissue over the high density outer skeleton characteristic of *Pocillopora damicornis*. Because of its thicker tissue layer, *Montipora verrucosa* can maintain more than six times as many zooxanthellae per unit surface area as can *Pocillopora* *damicornis*. While neither of these two species have appropriate growth forms for density band study, their dissimilar growth response to light conditions emphasizes the importance of understanding species-specific physiology in interpreting band patterns in more massive species.

Finally, acclimation of pigment content to new light conditions required approximately two weeks for both species. Natural instability in light conditions caused by daily changes in cloud cover, turbidity or tidal cycles may not allow time for pigment content to adjust to ambient conditions and therefore may retard growth. Since meteorological and oceanographic instability is seasonal in many locations, such daily fluctuations may be another contributing factor in density band formation. In addition, once pigment content had adjusted to a particular light level, the carotenoid/chlorophyll a ratio was found to be directly related to the light intensity. Consequently, the measurement of this ratio in corals at a known depth may provide a transient short-term indicator of water clarity.