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CORALLINE RED ALGAE IN TROPICAL WATERS AROUND PANAMA: MONITORING PAST AND PRESENT ENVIRONMENTAL CHANGES

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The formation of the Panama Isthmus in the Pliocene resulted in different environmental regimes for the Pacific and Caribbean waters around Panama. Prior to the closure, water passed freely at abyssal depths through the seaway. A wide variety of data suggest that environmental conditions were fairly homogenous in both the eastern tropical Pacific Ocean and the Caribbean Sea. Today, the two coasts of Panama experience dramatically different environmental regimes. Coastal hydrography along the Pacific coast is controlled by the interaction of trade winds crossing the Panama Isthmus in southwesterly direction and a strong low-pressure cell over southern Panama (Inner tropical Convergence Zone; D´CROZ et al., 2001). Seasonal upwelling is strong in the Gulf of Panama, where land topography is relatively low, which allows trade winds to blow across the land bridge in full strength. In the Gulf of Chiriqui, however, the high Talamanca range prevents trade winds from crossing the isthmus, resulting in reduced upwelling, which allows substantial reef growth in this area. Despite similar seasonal variations in salinity, temperature ranges show distinct differences between the two ocean bights: nearly constant temperatures year round in the Gulf of Chiriqui; seasonal temperature variations in the Gulf of Panama.

Coralline red algae are especially abundant in the Gulf of Chiriqui, where they occur with different species and growth forms: (1) thin, unilayered crusts (0-5 m below sea level), (2) multilayered, nodular rhodoliths on open shelf banks (20-50 m) affected by storm waves (Montuosa), and (3) open-branched rhodoliths in more protected shallow-water settings between islands (Secas, Contreras). Rhodoliths show a dominane of spheroidal gowth shapes indicative for a high-energy Rhodoliths pavement facies according to BOSENCE (1983).

Variations in the Mg/Ca ratio in coralline red algae have been widely reported to depict changes in (palaeo-) temperature of the ambient seawater environment (CHAVE, 1954; CHAVE & WHEELER, 1965; HENRICH et al., 1996; HALFAR et al., 1998, 2000). Growth banding in corallines has been used to calculate and compare growth rates in various environmental settings.

Corallines with open-branching thalli (*Lithothamnium* sp.) display a distinct banding with light and dense layers. Light bands consist of cells with thin walls and open lumina, whereas dense bands display thicker cell walls and narrow cell lumina. Mg/Ca mapping with a microprobe detector and EDX analysis along a profile along the thallus axis revealed a significant difference between open and dense layers: light bands show relatively high Mg values of 17.82 wt% (mean) and a Mg/Ca ratio of 0.21, dark bands have comparatively low values of 12.94 wt% Mg (mean) and a Mg/Ca ratio of 0.14. Comparison of Mg/Ca ratios in rhodoliths from the Gulf of Chiriqui and the Gulf of Panama suggests differences in growth rates of rhodoliths, which are explained by the seasonal temperature differences between the two gulfs.

Lithothamnium crassiusculum (Gulf of California) dwells under different hydrographic conditions: at nearly constant salinities (35.1-35.5‰) but with seasonal temperature fluctuations (19°-30°C). Mg concentrations range from 13.2 – 22.5 mol% $MgCO_3$ (Mg/Ca ratio 0.15 - 029) (HALFAR et al., 2000). In contrast, *Lithothamnium* sp. from Gulf of Chiriqui dwells under nearly constant temperatures (annual SST range 27°-29°C; 26°-27 °C in 40 m water depth) but strong salinity fluctuations (SST 25-35‰). Differences in Mg/Ca ratio between light bands (0.21) and dark bands (0.14) in the Panama species, therefore, suggest a much stronger salinity control of the Mg/Ca (palaeo-) thermometer signal than expected earlier.

In summary, the geochemical and isotope analysis of the coralline algae, in combination with the detailed analysis of corals and mollusks, will allow a precise determination of the seasonal variations in the different sea bights in which the above described coralline red algal carbonate community developed. This precise correlation will help us to unravel the evolution of the carbonate biotic communities within the sedimentary basins in response to the closure of the Isthmus of Panama.

THE LAST RUDIST ECOSYSTEMS IN EAST-CENTRAL MEXICO

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The Cardenas Formation in east central Mexico is of Maastrichtian age and contains some of the last rudist assemblages known worldwide (MYERS, 1968; JOHNSON & KAUFFMAN, 1996; SCHAFHAUSER et al., 2003). We analysed the biostratigraphy, depositional environment, and