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Assessing Contemporaneous Formation of Microbialites and Corals In a Post-Glacial Maximum Reef: Offshore Mozambique

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Rationale

Microbialites have often been regarded as indicators of rapid environmental changes such as rapid sea level rise, where they replace phototrophic and heterotrophic organisms as carbonate producers (Camoin et al. 2006)

However, a healthy reef with a diverse coral population and abundant microbialites that was recovered in a a 2- meter core section offshore indicates a co-existence of phototrophic and heterotrophic organisms.

Heindel et al. (2012) propose that sulfate-reducing bacteria play a crucial role in microbial carbonate precipitation in post-glacial reefs based on lipid markers and chemical analysis.

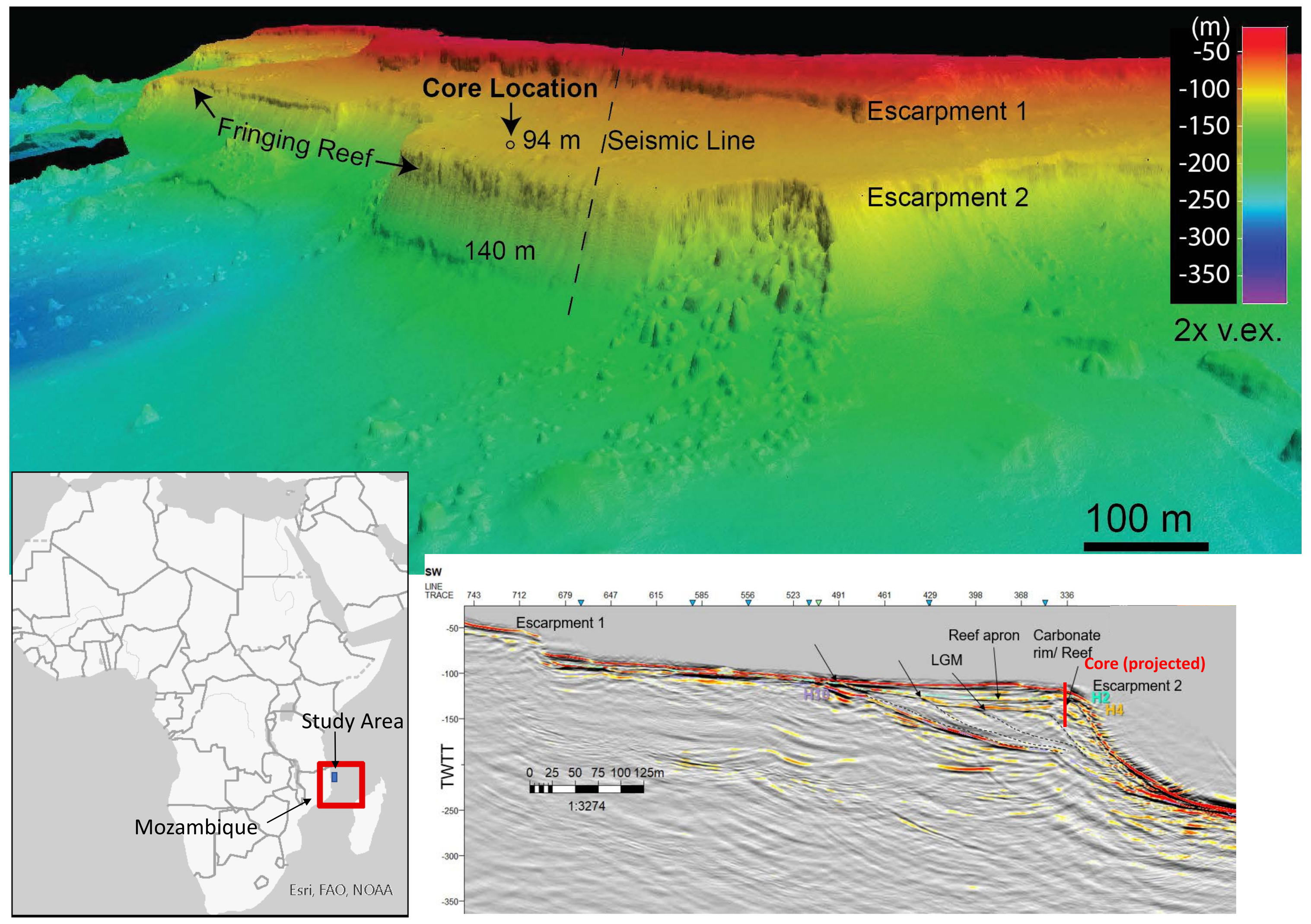
Objectives

To quantify the amounts of corals, microbialites, algae and sediments within the reef.

To show how intimately related the coral and microbialites are to one another, yet how variable the mineralogy and geochemistry are between the reef's constituents growing at the time.

To investigate types of microbialites cement within the coral framework on a macro- and micro-scale and ultimately assess their formation.

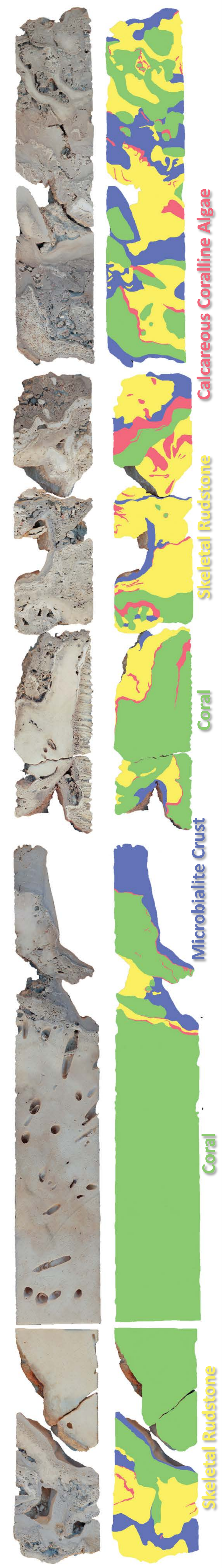
Geologic Setting



Multibeam bathymetry data from offshore Mozambique reveal a shelf with a continuous fringing reef cresting at -95 m water depth. Core section ES-103-BH was drilled through this reef, at – 115 m, which is where sea level was at the beginning of Meltwater Pulse 1A in the last deglaciation.

The shelf-slope system is a mixed carbonate siliciclastic system; the upper and lower escarpments are carbonate shelf edges built by fringing reefs. This shelf was never been exposed to meteoric alteration.

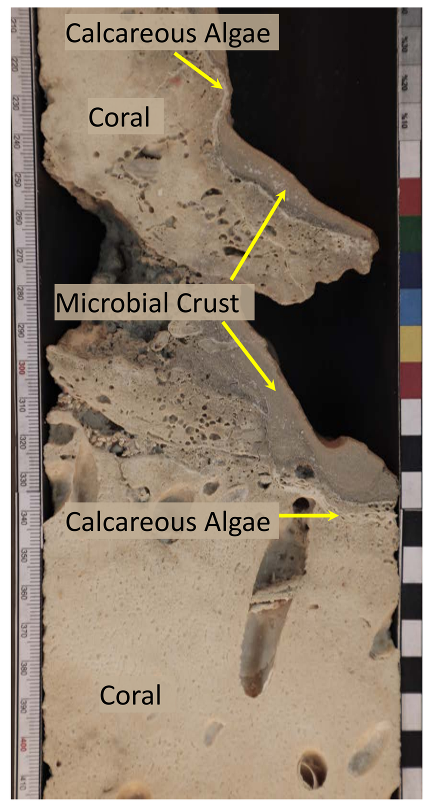
Core

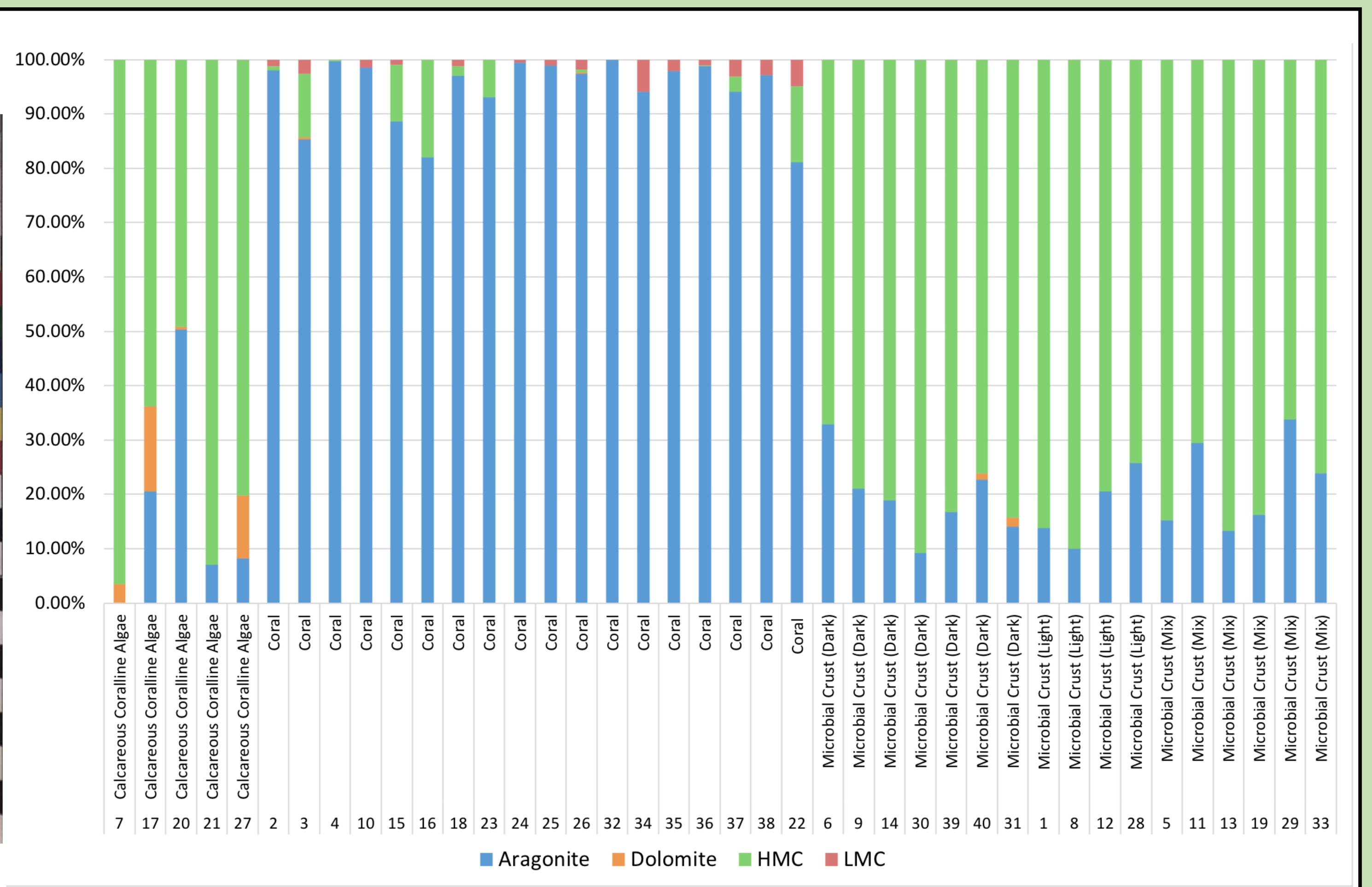


Coral	53.55%
Skeletal Rudstone	28.47%
Microbialite	14.14%
CCA	3.84%

Mineralogy

Carbonate Producers

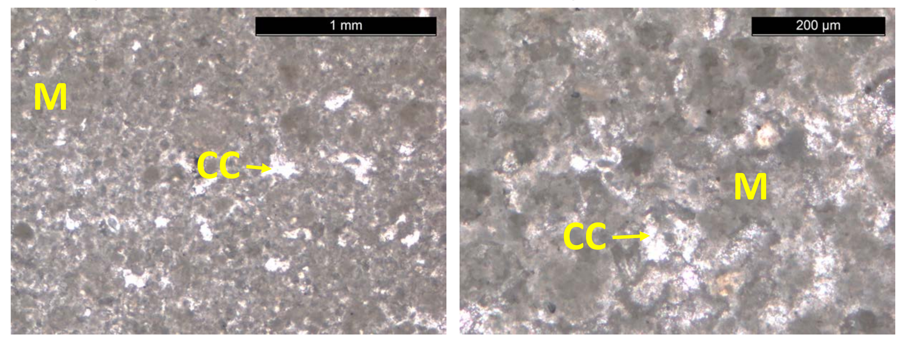




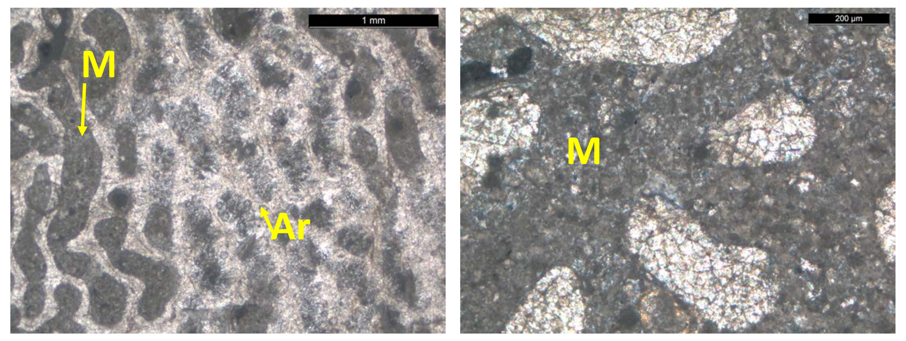
The mineralogy produced by carbonate secreting organisms in the reef is highly variable. Corals precipitate aragonite; the varying amounts of high magnesium calcite (HMC) in corals are microbial cements. Microbial crusts and Calcareous Coralline Algae (CCA) are predominantly HMC. Dolomite within CCA and Microbialites suggests early dolomitization.

Microbial Crust & Cements

Type 1: The microbialite crusts have a peloidal fabric with interpeloidal voids often filled with crystalline cement (CC).

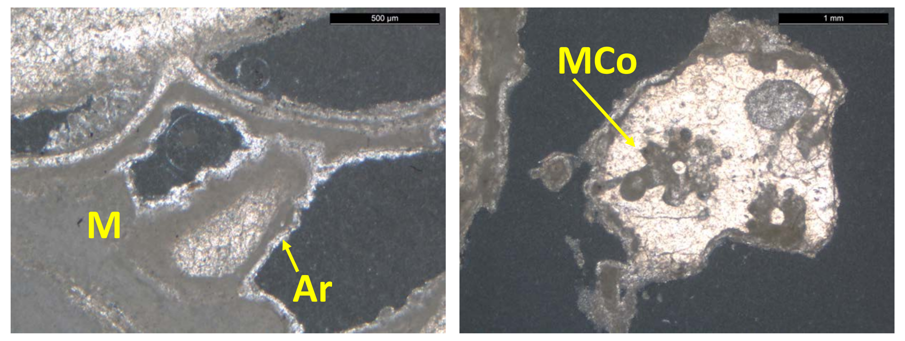


Type 2: Microbialite (M) infilling of pores of coral skeleton.

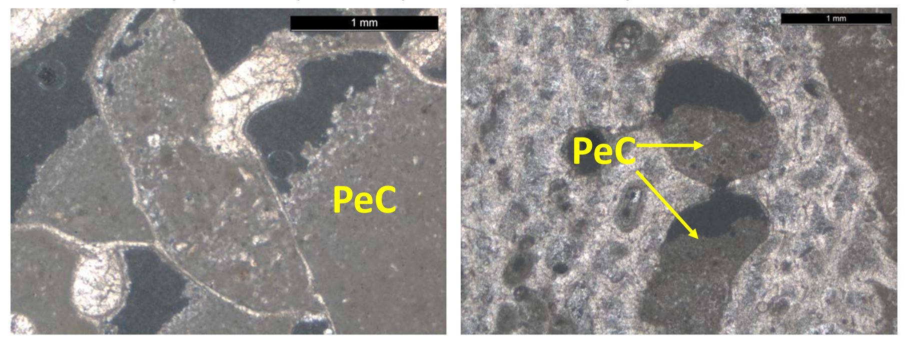


Type 3: Layer of microbialite followed by aragonite (Ar).

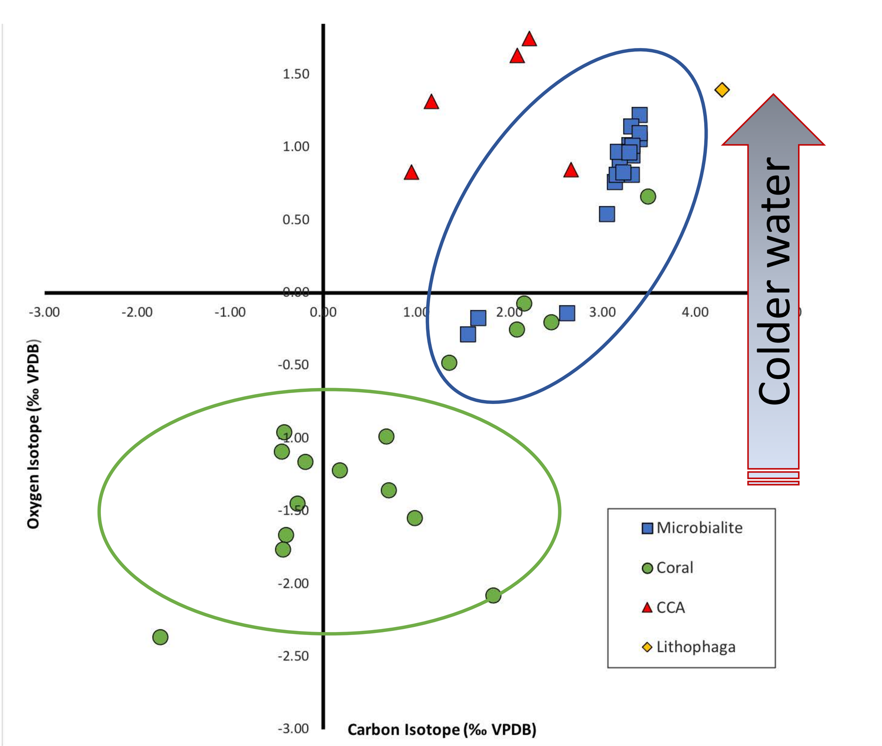
Type 4: Microbialite coating (MCo) around a particle.



Type 5: Layered peloidal cement (PeC) within a coral; top has interpeloidal porosity and rims of crystalline cement.

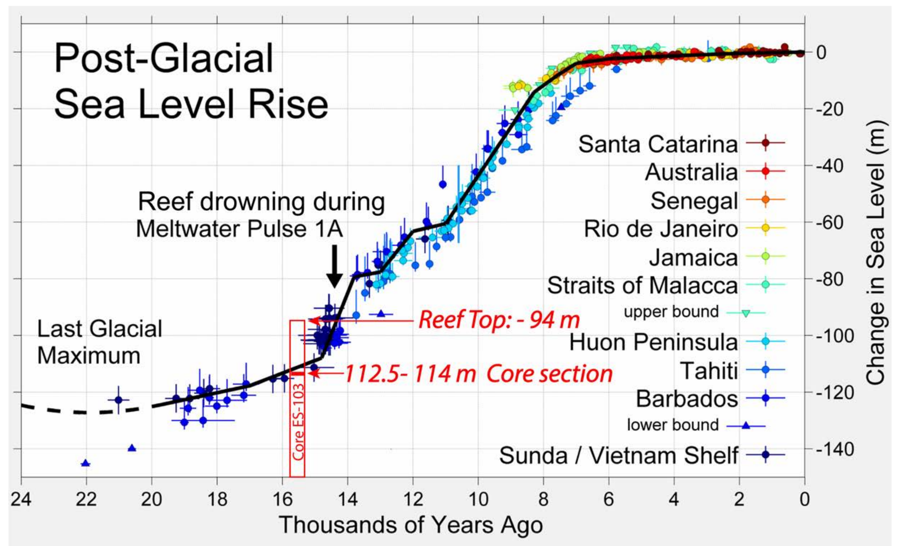


Stable Isotopes



More positive $\delta^{18}O$ in the Microbialites than in the corals indicate precipitation in colder and deeper water.

Interpretation



The coral reef formed during the Last Glacial Maximum but drowned during the fast sea level rise in Meltwater Pulse 1A. The microbialites continued to grow on and in the coral framework as sea level rose during the Holocene.

Methods

We performed a macroscopic core description, 2D quantification of textural components, and petrographic thin section analysis to determine the composition of the reef on various scales.

The geochemical analyses consisted of X-ray diffraction analysis for mineralogy and the determination of the stable isotopes of calcareous coralline algae, microbialites crusts, and corals.

Results

Various forms of the genus *Montipora* dominate the coral assemblage in the core. Other species include *Porites*, *Pocillopora*, *Platygyra*, *Acropora*, and *Galaxea*.

Microbialite crusts developed in the cavities of the coral framework, ranging in thickness from a few millimeters up to 6 cm; they represent a significant structural and volumetric component of the framework and form up to 15% of the rocks.

Five types of microbial cements are observed in the coral framework.

The corals are mostly aragonite with varying but small amounts of high magnesium calcite (HMC) that reflect the microbial cement documented in thin sections.

Based on the stable isotopes the microbialite crusts formed in colder water than the corals and likely developed a few hundred years after the coral communities.

Ongoing: Dating with C-14 of corals and microbialites is expected to corroborate our interpretation.

References & Acknowledgments

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