Sample Collection & Pre-treatment
1. Natural Carbonate Sand: no autoclaved.
2. Dominant Epilithic Organic Mat (Phot.)
   - Big 1-15 days with medium hydration, 1 wk.
3. Guano + Leaves (GU): Heterotrophic nutrient media + hot-water extraction (CNP; 1.30.0.01) & inoculum source.

Experiment Setup
- 4 x 50cc Syringe Microcosms with sand, different microbial communities (Phot. & Ht.) and mixed marine-water conditions. 3 replicates each.
- Placed in a box to control light exposition. 3°C.
- x3 S-doped seawater (standard, added as SrCl₂, 1H₃O) to track MCP.
- Nutrient media: BG11 (Phot.) and GL extract (Ht.).

RESULTS & DISCUSSION

Water Chemistry
- Monitored the T, pH, and the T₄₅ outputs of high-tides, every 7 days, during 3 weeks.
- Each data point is an average for the 3 replicates in each syringe microcosm.

Microbial Mat Characterization
- FE-SEM: Complex algal & microbial filamentous & unialgal communities with abundant EPS. EPS of phototrophic microorganisms provide PDO groups that attract Ca²⁺ and Mg²⁺ ions to promote carbonate organomineralization.

MCP Cement Characterization
- A Grain surfaces & voids largely covered by apparent microcrystalline calcium carbonates. NaCl evaporites code crystals hide the carbonates.
- B Micro-lasings with carbonate sub-products. Microcrystalline carbonates (A) gather under the mat.
- C Heterotrophic microorganisms & abundant EPS in the cavities, lesser presence of micritic carbonates.
- D No evidence of carbonic mineralization on grain surfaces and voids. Some evaporites and locally, bacteria found.

Analysis
- DNA Analysis: Bacteria & Archaea 9250/1302 primer amplification
- DNA Analysis: Kingdom Taxonomy Summary

Materials & Methods

Introduction
- The experimental approach using natural carbonate sand, mixing of fresh-marine waters, and a naturally enriched autotrophic-heterotrophic microcosm aims to reproduce Horion Island beachrock through Accelerated Microbial Carbone Precipitation (MCP).
- Beachrocks are early diagenic coastal sedimentary formations derived from the precipitation of CaCO₃ cements in the intertidal zone. Natural beachrocks have attracted interest as models to understand MCP.
- MCP can occur as a by-product of metabolic activities (e.g., photosynthesis, ureolysis, denitrification, ammonification, sulphate reduction and methane oxidation). MCP has been reproduced with the aid of photosynthetic bacteria in specific microcosms. Heterotrophic microbes frequently associated with photosynthetig can increase dissolved inorganic carbon (DIC) and promote carbonate precipitation. Thus, phototrophic and heterotrophic microbes have a greater potential to alter the geochemy and induce MCP.

Area of study
- Dense Pisonia grandis forest and thousands of seabirds producing tonnes of guano, enrich groundwater in PO₃⁻ & NO₃⁻, which reach mixing zone at the beach, creating the Heterogenous microbial communities cover the beachrock.

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