EXAMINING THE ROLE OF MICROBIAL CONTRIBUTION TO CEMENTATION

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PROJECT OBJECTIVES

- Determine the potential contribution of microbes to cementation processes on carbonate slopes and reefal boundstone deposits.
- Describe and interpret sedimentary structures and textures within reefal boundstone deposits.

PROJECT RATIONALE

The strong control of cyanobacteria, algae and fungi in binding carbonate grains and triggering cementation in the form of micritic meniscus cement (Fig. 1) is well documented in the formation of grapestones, aggregate grains and firmground crusts and hardgrounds in the vicinity of high-energy carbonate sand bodies (Fabricius, 1977; Hillgärtner et al., 2001). This early microbial binding often precedes the typical marine cementation, including acicular and fibrous aragonite or bladed rinds. Extensive microbial binding is also identified as the controlling factor for early stabilization of carbonate slopes that, in combination with subsequent rapid cementation, maintains the steep slope angles around carbonate platforms and shelves (Reolid et al., 2017).

Some Silurian reef slope deposits at the Pipe Creek Union Quarry in Indiana are notable for their unusual inclined-flank-beds lithofacies that dip at an angle of around 45° (Santiago et al., 2018). Although marine cements are recognized as an important slope stabilizer, the contribution of syndepositional microbially-derived cement cannot be excluded, as microbial binding can be an important contributor to slope stabilization and reef maintenance.

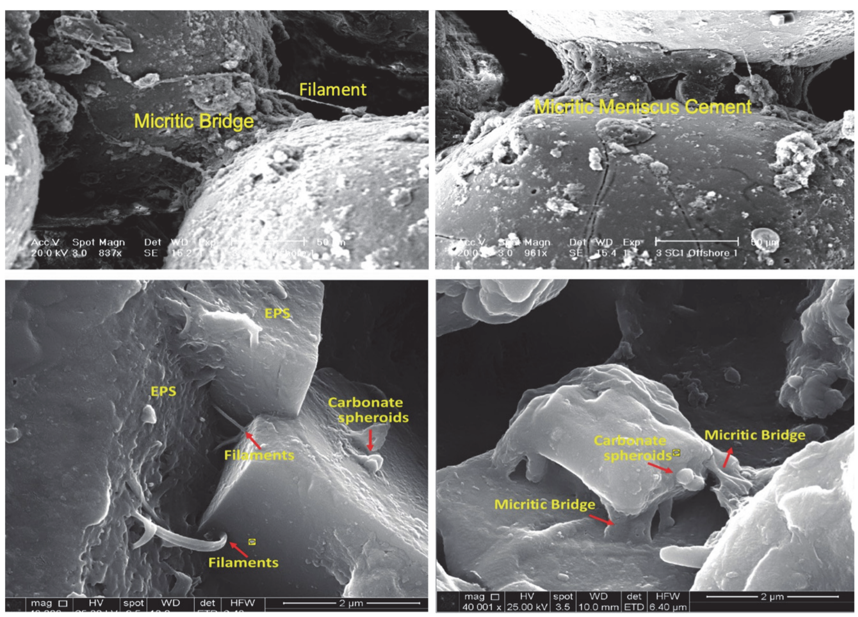

Figure 1: SEM images of modern micritic cements in intraclasts from ooid shoals at Schooners Cay and fossilized filamentous structures (interpreted as mineralized cyanobacterial filaments), fossilized EPS, carbonate spheroids, and micritic bindings in reefal boundstone deposits from the Michigan Basin (from Santiago et al., 2018).

Likewise, microbial micrite and binding cement play a role in reef maintenance, and in preventing reefs from being overwhelmed by rubble (Leinfelder, 1992). Amid the growing number of studies supporting the role of microbes in binding and trapping, and precipitation of micritic cements, this study aims to characterize signatures of microbial fingerprints that potentially denote *in situ* production and syndepositional lithification processes.

Approach and Deliverables

To elucidate the potential contribution of microbial cementation in the maintenance and stabilization of ancient reefal slopes, thin section petrography, SEM analysis, and confocal microscopy analyses will be conducted in Holocene sediments from Great Bahama Bank and Silurian upper slope deposits from Pipe Creek Jr., Indiana. Identification of microbes will be based following microscopic and microbial morphotypes. Special attention will be given to fossilized remnants of extracellular polymeric substances (EPS) given their strong preservation potential and utility as predictors of microbial life. Moreover, EPS is one of the key components for organomineralization. We will document any lithologies consistent with microbial influence such as micritic coatings around skeletal grains and/or, fibrous calcite cement around organic material, patterns of lamination and occurrence of micropeloidal fabrics, etc.

Implications

Results from this project will assist in elucidating whether abiotic or microbial cementation dominates the reefal boundstone in the modern and ancient and whether reservoir modifications can be partially attributed to syndepositional microbially-derived cement. This will have important implications for the oil industry as reef-related marine cementation is a key player in the porosity evolution of economically important ancient reefs.

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