Evaluating Porosity Evolution within the Stacked Pleistocene Reef Sequences of Glover's Reef, Belize

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Project Purpose

1. To evaluate the effects of multiple sea-level cycles on porosity evolution and to determine the hydrological zones responsible for the diagenetic features observed.
2. To identify trends in reservoir quality in a stacked reef sequence by applying a quantitative approach to the petrography of early diagenetic (pre-burial) features within an age-constrained stratigraphic context.

Approach

Quantitative sedimentological and diagenetic data sets are essential building blocks of forward models and reservoir quality studies. This study focuses on Glover's Reef, a Caribbean atoll that records multiple sea-level highstands within the last 500,000 years (Figure 1), preserving a variety of depositional facies and an early diagenetic overprint. Data sets collected in this study include petrographic data from rotary cores to identify depositional facies and diagenetic features, fluid inclusion Tm ice data to identify the origin of diagenetic features, and petrophysical measurements to evaluate phi/K relationships. These data sets are complemented with point counting of grain, cement, and pore types. In addition, Amino Acid Racemization (AAR) dating is employed to improve age control on the stacked reef sequences.

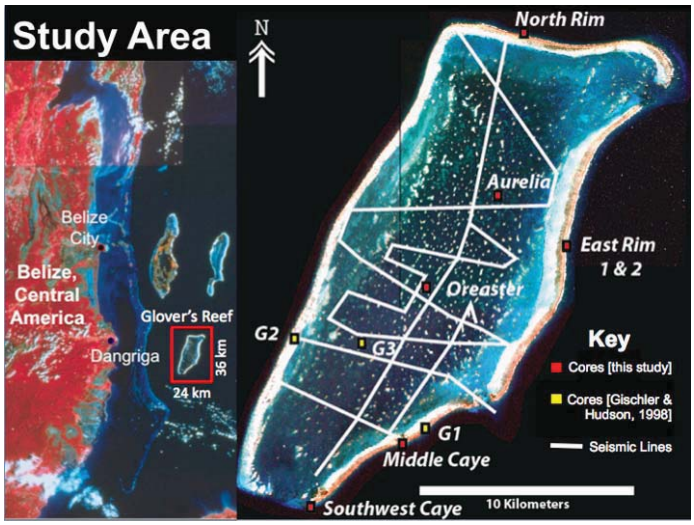

Figure 1. Study area of Glover's Reef, a 260-km2 reef-rimmed platform off the coast of Belize, shown with core locations and seismic data.

Project Description

By using cement stratigraphy and fluid inclusion analyses, we can trace cement phases back to specific sea-level events and hydrological zones, determining which had

the most significant effect on the final reservoir quality of the rock. These insights, coupled with sedimentology, can instruct forward modeling exercises that explore porosity evolution through time. Ultimately, we hope to improve the prediction of reservoir quality "sweet spots" by investigating the relationships between facies, stratigraphy, sea-level cycles, and diagenesis.

With respect to age control, we will target samples of *Montastraea annularis* for AAR dating because this Quaternary dating method, based on the deterioration of indigenous amino acids in organic matter, is species specific (Miller & Brigham-Grette, 1989). Results from a pilot test on samples from the Southwest Caye core show good separation of Holocene and Pleistocene samples as well as clustering of the Pleistocene samples from the same exposure horizon, suggesting this method will be successful in providing age control (Van Ee et al, 2010).

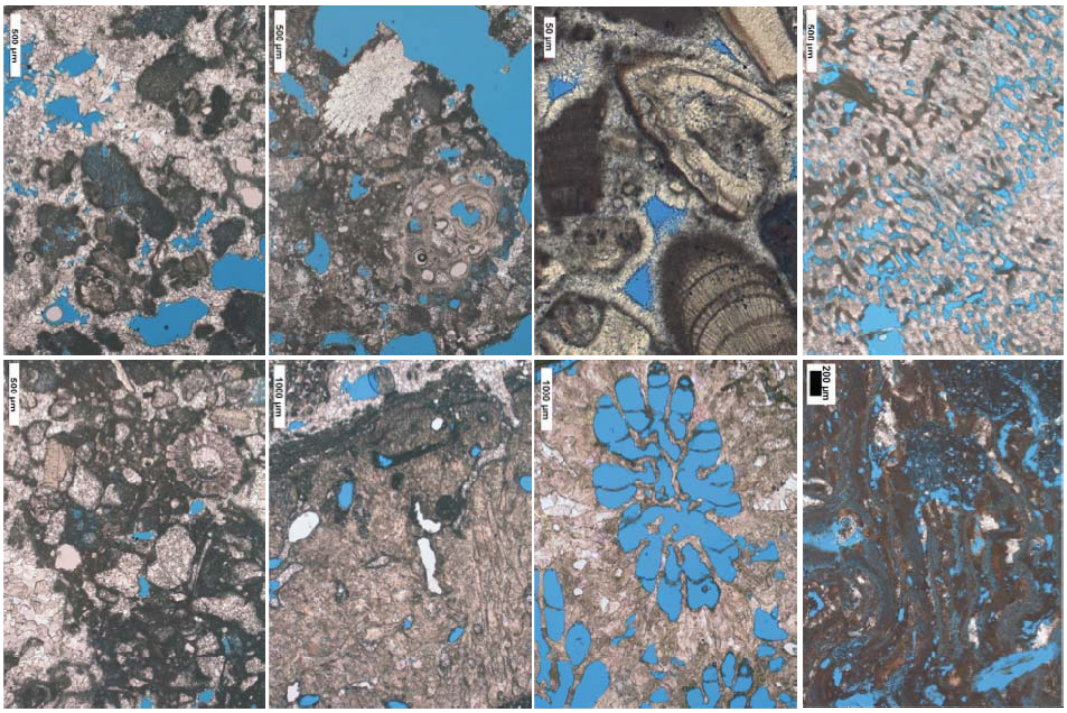

Figure 2. Variations of grain, cement, and pore types in samples from Glover's Reef, Belize.

Key Deliverables

This project provides quantitative measurements of grains, cements, and pore types within a comprehensive stratigraphic framework. Data can be formatted for implementation into CARB3D+ modeling software upon request.

References Cited

Miller, G.H., and Brigham-Grette, J., 1989. Amino Acid Geochronology: Resolution and Precision in Carbonate Fossils. Quaternary International, 1, 111-128.

Van Ee, N.J., Eberli, G.P., Buijs, G.J., and Gischler, E., 2010. Spatial Variation of Facies and Early Diagenesis on Glover's Reef. Annual CSL Review Meeting, October 11-12.