Petrophysical Characterization of Plio-Pleistocene Reef Systems in the southern Dominican Republic

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Project Purpose

The Pleistocene reefs that developed in the Dominican Republic over the past 1.8 million years provide a unique opportunity to study the complex three-dimensional architecture and controlling factors of fringing reef development during high frequency sea level cycles (see prospectus by Klaus et al.). Coral reefs present special challenges for geological and geophysical studies because reef growth is highly variable even over a small spatial scale (Jordan and Wilson, 1998). A dedicated ground-truth data set needs to be developed for assessing the variability in petrophysical properties in the reef rocks.

Scope of Work

Generally, carbonate systems are difficult to image using reflection seismic technologies due to their spatially highly variable acoustic properties as a result of their intrinsic pore systems during evolution and diagenetic overprint. Only the facies transitions of reefs to surrounding depositional environments are usually visible on high quality seismic imagery. As a result, internal reflections of reef bodies are mostly incoherent and lack information on internal anatomy and spatial distribution of physical properties. To advance the understanding of the acoustic and hydraulic behavior of such complex systems, we aim to measure a full data set of the Pleistocene carbonate rocks from the Southern Dominican Republic for petrophysical properties.

Key Deliverables

This project will provide an overview of the factors controlling petrophysical properties in carbonate reefs from the Dominican Republic. In addition, we will assess the influence of both the complicated textures and pore types on the velocity-porosity and porosity-permeability relationships.

Project Description

We have collected fourteen one meter cores and sixteen hand samples from different terraces, which represent various carbonate lithologies, depositional environments, and diagenetic processes (Figure 1). Each of these cores and samples will be selectively plugged based on different lithologies and depositional environments for further measurements and thin sections. Subsequently the following workflow will be applied:

- Cut thin sections for rock and pore typing and digital image analysis.
- Conduct petrophysical measurements (acoustic velocity, porosity, permeability).
- Generate a catalogue that captures the relationships between geological parameters and petrophysical properties.
- Finally, integrate the results with the results from the geophysical imaging.

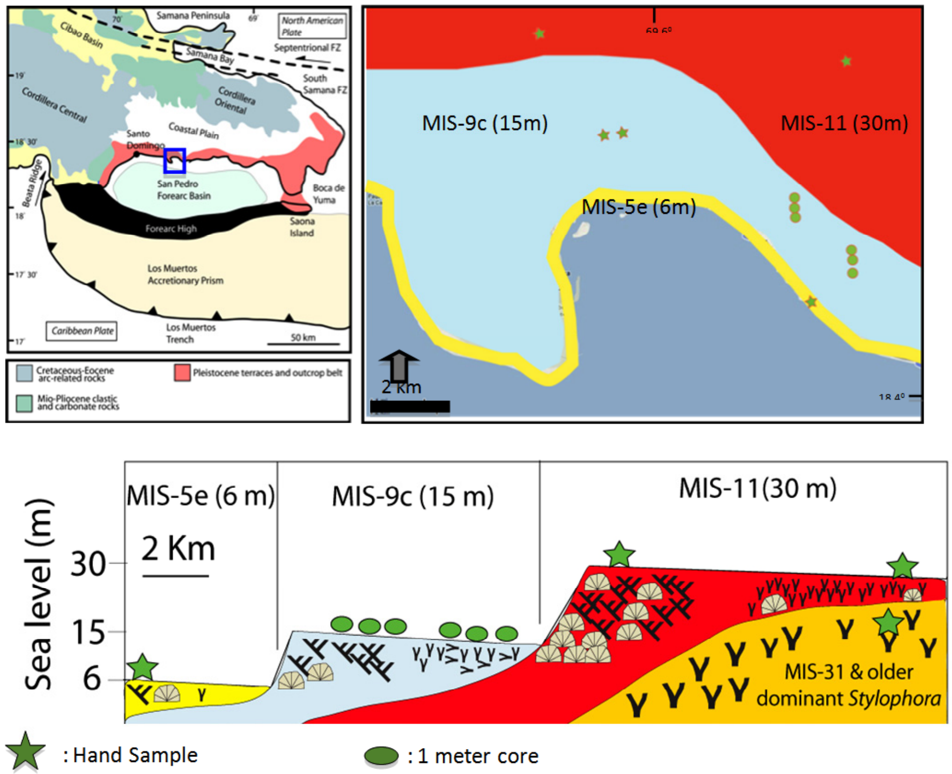

Figure 1. (Top) Regional geologic map. Blue inset corresponds to maps of various documented terrace elements. Tentative ages have been ascribed and referred to as marine isotope stage (MIS). (Bottom) Cross-section through the terraces showing the sample locations (stars are hand samples; circles are one meter cores).

Expected results

The geological and geophysical data will provide a 2D high-resolution model of the reef architecture aiming to reveal internal geometries as a function of the spatial evolution of the reef system. The petrophysical experiments will enhance insight in key parameters controlling acoustic properties in reef environments, such as pore type size and distribution, and provide a comprehensive understanding of the variability of both acoustic and hydraulic properties in these reef systems.

References

Jordan, C and Wilson, J.L., 1998 Reefs: Geologic considerations for geophysicists, The Leading Edge, no. 3 p. 325-328