CARBONATE SLOPES IN THE GULF OF AQABA

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PROJECT OBJECTIVE

- Analyze slope carbonates from the Gulf of Aqaba, with the goal of revealing what organic and inorganic mechanisms are at play to stabilize and bind sediments in this location.
- Determine the role of microbial and marine cement on the stability of the slope.
- Examine if the warm waters in the Gulf of Aqaba produce a different diagenetic cementation pattern than the marine diagenesis in cold oceans.

PROJECT RATIONALE

The Gulf of Aqaba located along the African and Arabian margins, forms the southern end of the dead sea transform. This young and actively rifting basin is considered the most seismologically active region in the middle east (Abdelazim et. al, 2023). As a result, there is considerable evidence for tsunamigenic potential due to submarine landslides in the Gulf of Aqaba (Purkis et al., 2022). With rapid urbanization along the shores of the Gulf, combined with the morphological characteristics of the narrow basin and steep slopes, it is essential to understand the composition and stability of carbonate slopes in the Gulf of Aqaba.

Another unique feature of the Gulf of Aqaba is the warm water in the Gulf of Aqaba that is similar to water temperatures in the Cretaceous Ocean (Fig. 1). Water temperatures do not significantly decrease with depth but are above 21°Celsius, even at depths of 1700 meters. In addition, due to the restricted nature of the basin, the Gulf of Aqaba is hypersaline, with an average salinity of 40 psu (Purkis et al., 2022). These unique conditions dictate not only the faunal assemblages that build frameworks and create sediment, but might also influence the diagenetic processes that transform these sediments.

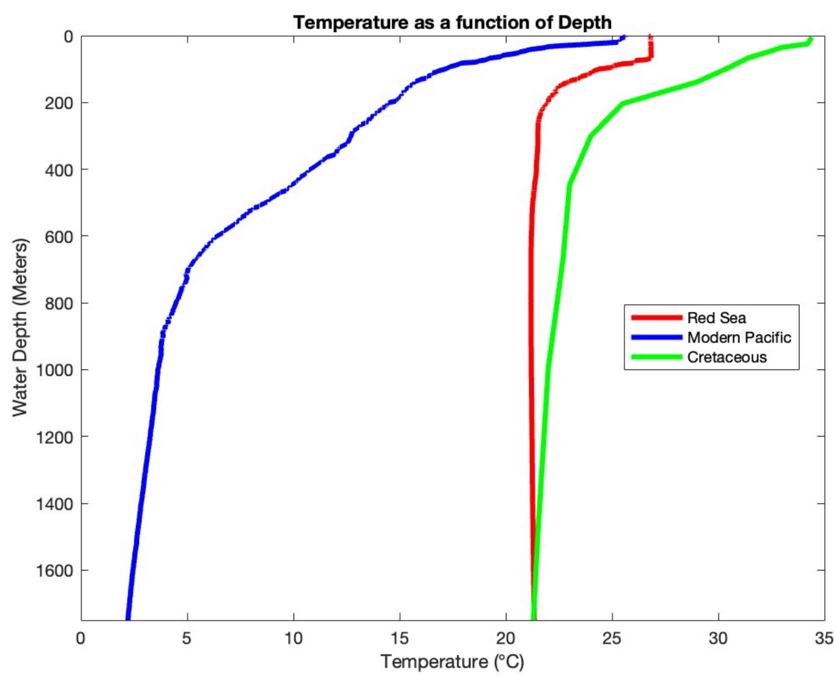

Figure 1: Temperature profile of the Red Sea, Modern Pacific and the Cretaceous. The Red Sea profile is unusual as temperature remains warm to great depth, while in most modern ocean basins temperatures decrease rapidly with depth.

Sample Set and Methodology

We plan to analyze a total of 30 rock samples that were collected from varying depths, ranging from 0 to 700 meters water depth, using the ROV Neptune, deployed on research cruises aboard R/V OceanXplorer in 2020 and 2022 (Fig. 2).

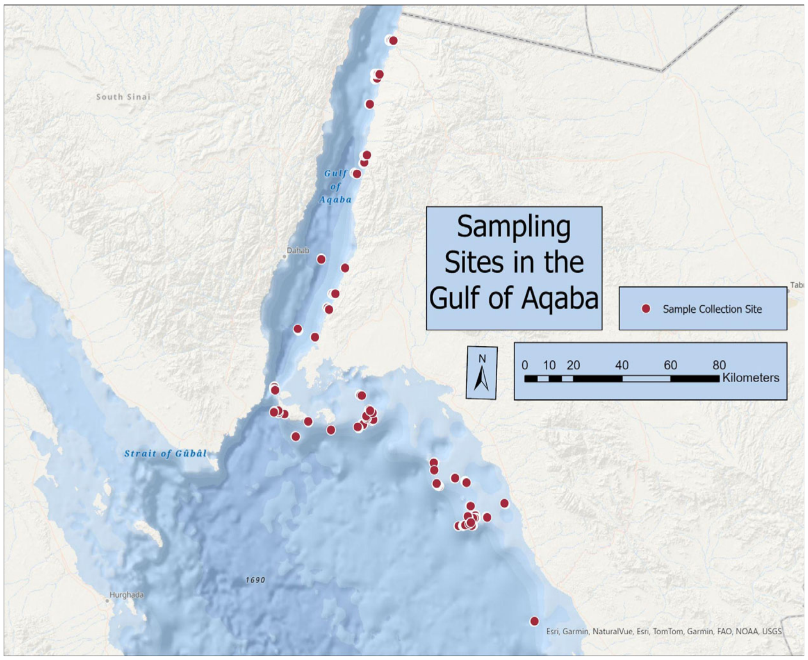

Figure 2: Sample collection by ROV Neptune in the Gulf of Aqaba and surrounding areas.

The sample set will be studied in regard to their composition and how sediments are bound and cemented. Mineralogical composition will be determined using X-Ray diffraction. Geochemical analysis will include stable isotope analysis. Visual inspection and description of the samples will be followed by the analysis of thin sections with a petrographic microscope to determine grain composition and diagenetic alterations. Initial results of the thin sections reveal abundant microbial cement (Figure 3). Consequently, characterization of microbialites will be carried out using Scanning Electron Microscope (SEM) analysis following the procedure outlined in Diaz and Eberli (2022).

Initial Results

Petrographic analysis has shown the diverse composition of this sample set. At both shallow and deep depths (30 to 396 meters water depth), scleractinian corals represent an important agent of slope construction, commonly encased with abundant crustose coralline algae and other encrusting organisms (Figure 3 a, c). Abundant encrustation foraminifera and calcareous red algae of coral fragments but also on hardground surfaces is common. The abundance of serpulids points to the importance of serpulids in bioconstructions in the Gulf of Aqaba. Below 500 meters water depth, foraminiferal packstone represent the majority. In few samples, quartz and felspar are admixed (Figure 4), documenting the occasional input of sediment from the rift shoulder. Many samples are covered by a thin iron-manganese crust, conforming the notion that the “Red Sea is an under-supplied marine rift basin” (Taviani 1989).

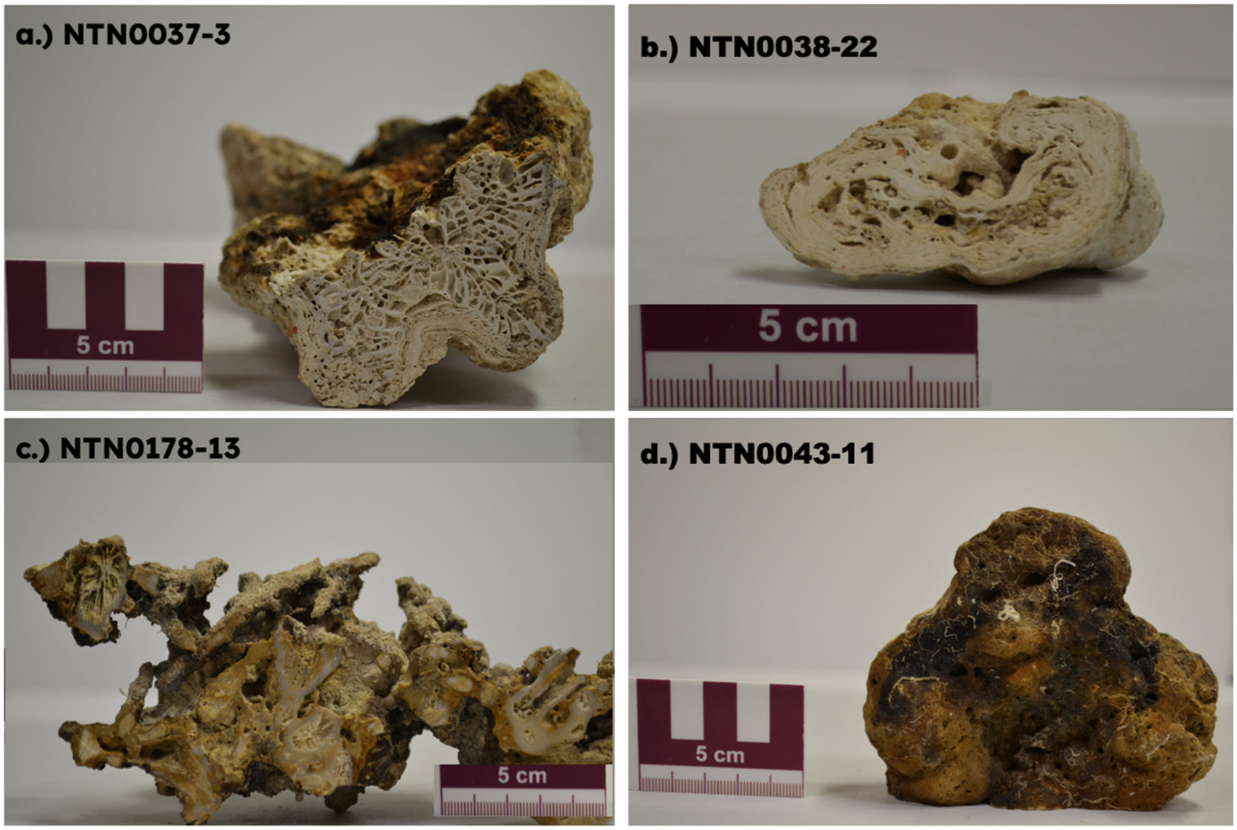

Figure 3: a.) Sample NTN0037 coral with encrusting organisms. b.) NTN0038-22 serpilud encrusted with calcareous red algae. c.) Assembly of rugose coral rubble. d.) Hardground on foraminiferal packstone with with serpulids.

Cementation of the samples is dominated by dark micritic cement that is some cases fills even large cavities (Figure 4a) and can be the only cement inside of grainstones (Figure 4c). Another unique characteristic is the occurrence of large fibrous splays and botryoids (Figure 4).

SIGNIFICANCE

The composition of carbonate slopes in the Gulf of Aqaba has the potential to provide vital information on the risk of slope failure and tsunamis in the region as it undergoes rapid urbanization. In addition, understanding the composition of carbonate slopes in the Gulf of Aqaba gives insight into how slopes are deposited and altered in an actively rifting basin with unique temperature and salinity conditions.

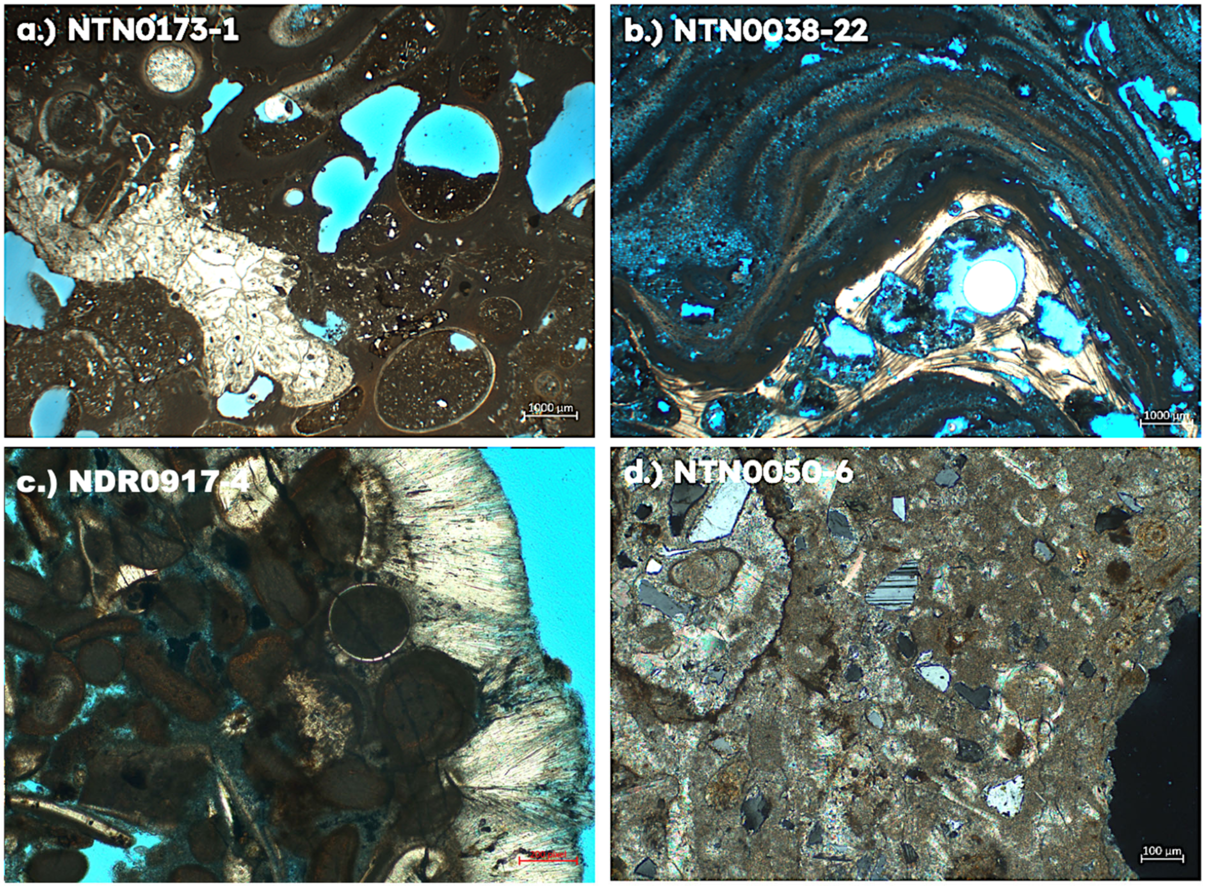

Figure 4: a.) Thin section of sample NTN0173-1, with a bryozoan and serpulid tubes filled with fine sediment and cemented by dark micritic cement. b.) Thin section of NTN0038-22 displaying coral fragment with encrusting foraminifera. c.) Skeletal grainstone with micritic cement and splays of fibrous aragonite on the outside. d.) Skeletal packstone with admixtures of quartz and feldspar.

References

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