Carbonate Contourite Drift Systems – Expanding the Data Base on Types and Dimensions

Gregor P. Eberli, Sara Bashah, and Christian Betzler[1]

1) University of Hamburg

Project Objectives

- Assemble examples of erosional features and depositional bodies of bottom currents in carbonates.
- Provide dimensions of the various contourite drift systems.
- Establish a holistic sedimentary model of current controlled deposits in carbonates.

Project Rationale

Carbonate environments inhabit the realm of the surface, intermediate and deep currents that contribute to ocean circulation. Last year the effect of these currents on deposition was evaluated. Carbonate characteristics, such as sediment production, export of sediment into the bottom currents, and their distinct physical properties, were examined to determine how these affect the transport and depositional behavior of carbonate particles in the current. In addition, we demonstrated how the rugged topography of many carbonate provinces causes a heterogonous interaction between bottom currents and carbonate buildups, producing carbonate specific drift bodies (Betzler et al., 2014, Lüdmann et al., 2018, Principaud et al., 2018, Eberli and Betzler, 2019). In recent years, results from several research expeditions to carbonate provinces with a strong current influence have added a wealth of information to comprehensively describe carbonate contourite systems. The goal of this ongoing project is to assemble additional examples of coarse- and fine-grained contourites drift systems, describe their dimensions and relate the architecture and composition to the processes that form these sedimentary bodies.

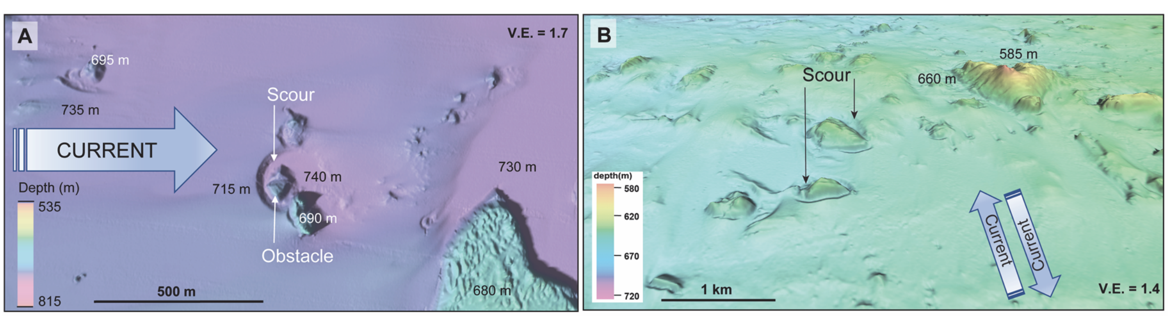

Figure 1: Examples of erosional features from bottom currents around obstacles. (A) A dominant north-flowing current produces a composite scour in fine-grained carbonate drift around three blocks in the Santaren Channel, Bahamas. (B) Scours around blocks covered by corals in a bi-directional current regime in which the depositional trail in the lee of the obstacles is not well-developed. Toe-of-slope western Great Bahama Bank.

Data Sets and Approach

Seismic and multibeam data from several expeditions with colleagues from Germany and France to the Bahamas and the Gulf of Mexico are available for this study. We also received the seismic data set from the Marion Platform that was collected for ODP Leg 194. These data will be studied with regards to the current features. In addition, we plan to screen literature, describing modern and ancient carbonate contourite drift systems, to assemble a comprehensive data base on these systems.

This information will be utilized to develop models of current-controlled erosion and deposition in carbonates that take into account the carbonate-specific characteristics of sediment production, grain density, and topography. These models are then compared to depositional models in siliciclastic environments.

Significance

Historically, depositional models of shallow-water carbonates generally considered ecology, sea level, and hydrodynamics to be the main controlling factors. More recently, internal waves have been recognized as a high-energy source (Pomar et al., 2012). Carbonate slope models until recently mostly considered gravity flows as the main factor controlling architecture. Recent discoveries of the importance of ocean currents in relatively shallow water (<300m water depth), and contour currents along the slopes, prompt a re-examination of these models. In particular, the "carbonate ramp" on seamounts and volcanic islands potentially is more current-controlled than described in existing models. Furthermore, the formation of prograding coarse-grained carbonate deposits in delta drifts add an entirely new aspect to carbonate deep-water deposition. Both the ramp model and delta drifts are potential reservoir facies that have so far been underexplored.

References

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