WHITINGS PROJECT PART II: CONSTRAINING THE CHEMISTRY OF INIMICAL WATERS ON GREAT BAHAMA BANK

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PROJECT OBJECTIVES

- Evaluate the impact of variable geochemistry of waters from the Straits of Florida on lime mud formation on Great Bahama Bank.
- Refine numerical models of aragonite saturation in the Whitings Zone.
- Examine spatial trends in stable isotope and trace element geochemistry of carbonate muds on Great Bahama Bank.
- Assess the role of 'inimical waters' on whitings formation.

PROJECT RATIONALE

Understanding the physical, chemical, and biological processes that form whitings in the Modern may provide key insight into the significance of geochemical signatures of lime mud in the ancient geological record. If whitings are created through the breakdown and resuspension of larger biotic grains (Broecker and Takahashi, 1966; Morse et al., 1984; Trower et al., 2019), their geochemical signature must be interpreted to reflect a confluence of environmental conditions, vital fractionation effects, and a longer period of time integration. In contrast, water column precipitates (Shinn et al., 1989; Robbins and Blackwelder, 1992; Robbins et al., 1997; Swart et al., 2014; Purkis et al., 2017) would represent instantaneous snapshots of water column chemistry with possible biological influence. Given the large quantities of lime mud in the geological record, understanding the significance of their isotopic and elemental signatures can generate new perspectives into biogeochemical cycling in early Earth history.

Figure 1: CTD Rosette onboard the R/V F. G. Walton Smith, which was used to sample water masses at various depths within the Straits of Florida on October 13, 2019.

APPROACH

In order to better constrain the geochemistry of the water masses that are mixed in the Whitings Zone, we will collate analyses of both unpublished CSL data and new samples from the Straits of Florida. Surface water samples were collected across the western half of the Florida Current in the Straits of Florida in October 2019. In addition, discrete water samples were collected for geochemical characterization using a CTD at the Hansell Oceanographic Site in the Straits of Florida (Fig. 1). These new water samples will be analyzed for alkalinity, DIC, and trace elements to better constrain the chemistry of the off-bank water masses at various depths. Our numerical models of saturation state will be refined for each mixing proportion using these datasets. Finally, we will conduct a geochemical characterization of the mud-sized fraction of surface samples on Great Bahama Bank including trace metals and rare earth element concentrations.

SIGNIFICANCE

Preliminary results suggest that the higher abundance of winter whitings is a consistent phenomenon over the past 15 years (Purkis et al., 2019), supporting the interpretation that the formation of inimical bank top waters plays a role in whiting formation. Refined numerical models of water chemistry and enhanced geochemical characterization of mud on Great Bahama will be used to elucidate processes of whiting formation that will enhance our understanding of the significance of geochemical records from lime mud through geological time.

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