

The interplay of ocean chemistry, sea-surface temperature, and hydrodynamics on aragonite mud-production in the ‘Whitings Hotspot’ of Great Bahama Bank

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Whitings are a sedimentological phenomenon where mud-sized aragonite crystals occur in the water column on Great Bahama Bank (GBB) and can be observed both *in situ* and from satellite imagery. Vast production of mud occurs on GBB prompting extensive research into the processes that generate whitings. Nearly 80 years of debate have produced a range of hypotheses for their formation, including resuspension of bottom muds, differential fluid flow in blue holes, and direct precipitation in the water column. Our recent works demonstrates that greater than 35% of whitings observations from 2012 occur within a well-defined zone which covers <1% of the platform (‘Whitings Hotspot’). In addition, seasonal variation was documented in the prevalence of whitings, where winter conditions are more conducive to whitings formation (70%) than summer conditions (30%). Furthermore, the hydrodynamic regime of off-platform circulation and on-platform currents was hypothesized to play an important role in creating conditions that favor the formation of whitings on Great Bahama Bank.

In this study, we link our prior observations of hydrodynamics with models of carbonate saturation state, simulation of on- and off-platform currents via a finite-element numerical model, sea-surface temperature (SST), and updated records of whitings frequency, size, spatial distribution mapped on daily MODIS Earth- observation data GBB in 2016. Carbonate saturation state maps are modeled using Geochemist’s Workbench, which incorporates the Pitzer equations into calculation of ion activity product. Preliminary results suggest the prevalence of winter whitings may be driven by large temperature differential between on- and off-platform waters that are hydrodynamically mixed in the vicinity of the ‘Whitings Hotspot’, generating a boost in carbonate saturation state. The lower prevalence of whitings in the summer may be the result of waters with similar temperatures mixing, which does not exhibit the same increase in saturation state observed in winter conditions. Furthermore, seasonal differences in the size of whitings have been observed during the course of whitings mapping, and statistical analysis of the size and frequency of whitings in the summer versus winter will be presented.

These observations provide important insights into the location and rate of mud-production on isolated carbonate platforms like GBB. In contrast to previous interpretations of facies distributions, our work demonstrates that the high concentration of mud in the lee of Andros Island is not the result of lethargic currents, but rather an elevated rate of mud-production by whitings. Constraining the relative impact of water chemistry, SST, and hydrodynamics on whitings formation will provide important insights into understanding the

formation of lime mud in the geologic record, where changing levels of atmospheric CO₂ will significantly impact the saturation state of aragonite in the oceans.