EVALUATING THE ROLE OF THE SUBTERRANEAN ESTUARY ON THE REDOX CYCLING OF URANIUM

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Introduction

Mixing of fresh, terrestrially-recharged groundwater and saline surface water in coastal aquifers ("subterranean estuary" [1]) affects the fate and transport of nutrients, metals, and contaminants. In a subterranean estuary below Waquoit Bay, MA, the aquifer was characterized by Fe- and Mn-hydroxides coated quartz sands between 0 and 2 m below seafloor (bsf); this zones redox framework consisted of an oxidizing environment overlying a reducing environment [2, 3]. Similar Fe-coated sands are observed within the upper meter of the aquifer below Indian River Lagoon (IRL), FL. In this study, we will look at the distribution of $^{234,\ 235,\ \text{and}\ 238}$U in the pore waters and sediments to evaluate redox cycling and water mass mixing within the IRL subterranean estuary.

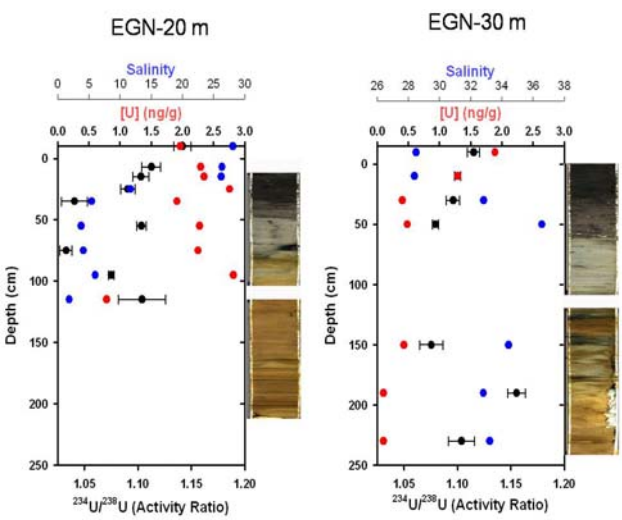

Figure 1: Pore water distribution of salinity, total Uranium concentration, and 234U/238U activity ratio collected 20 m and 30 m offshore into IRL accompanied photographs of cores collected adjacent to pore water samples.

Results and Discussion

A total of 285 pore water samples and approximately 50 sediment samples are to be analyzed for $^{234,\ 235,\ \text{and}\ 238}$U at the Geochemistry Division, NHMFL using the Finnigan ELEMENT ICP-MS; to date only 37 samples have been analyzed. The samples were collected from a shore-normal transect that extends approximately 30 m offshore into IRL; sampling depths extended from the water column to depths of 2.3 mbsf. Two pore water profiles are presented in Figure 1. Salinity distributions from the two sampling locations suggest a steep halocline in the aquifer between 20 and 30 m offshore. At 30 m offshore, ^{234}U becomes slightly enriched across the transition between the orange sands and the overlying grayish sands (1.8 m), but the trend is not sustained at greater depths. Also at this depth, the total U concentration is significantly lower than observed at the upper portion of the profile. At 20 m offshore, total U concentration is 2-3 times greater in the gray to black sediments than in the orange Fe-coated sands. This observation is in contrast to the observation that the sediments at depth are being oxidized (due to the apparent ferric hydroxides coatings on the sediment) since U is more mobile in its hexavalent state than its tetravalent state.

Conclusions

The preliminary U data presented here suggests that the REDOX framework within the subterranean estuary is in contrast to that suggested by the physical appearance of the sediments (i.e., Fe(III)-coatings). Upon further analysis, we will be able to compare both temporal and spatial variations of the subterranean estuary and determine exactly what role this feature plays in the cycling of uranium and evaluate the REDOX framework more completely.

References

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[3] M. A. Charette *et al*., Geochim. Cosmochim. Acta **69** 2095-2109 (2005).