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Quantitative Chemical Mass Transfer in Coastal Sediments During Early Diagenesis

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LONG-TERM GOALS

The long-term goals are to understand the fundamental mechanisms of biogeochemical processes that occur during early diagenesis, and to use that understanding to develop a predictive capability for assessing biogeochemical, physicochemical, and geotechnical consequences.

OBJECTIVES

This study is a collaborative effort between Dr. Samuel Bentley (Louisiana State University), Dr. Carla Koretsky (Western Michigan University), and myself. I focused on the development of inverse model code and its proper parameterization this year using the data obtained in the field (with collaboration with Dr. Joel E. Kostka, Florida State University, and with Dr. Bentley) and stochastic modeling technique transferred from Dr. Koretsky.

APPROACH

1. *Laboratory data collection*: Static characterization of pore water chemistry and dynamic characterization of redox environment near burrows were conducted in benthic mesocosms.
2. *Field data collection*: Static characterization of pore water chemistry and dynamic characterization of redox environment near burrows were to be conducted at field test sites in Skidaway Marsh (with Dr. Kostka).
3. *Reaction-transport (RT) modeling*: An inverse model for reaction rates and magnitudes were developed using Matlab framework. The model was parameterized and tested using the field and laboratory data (above) and Dr. Koretsky's stochastic model.

WORK COMPLETED

All planned activities of laboratory data collection, field data collection, and inverse modeling (see above) were completed.

RESULTS

The properly constrained inverse model indicates that the aerobic respiration rate and magnitudes of sedimentary microorganisms are significantly affected by their interactions with macroorganisms.

IMPACT/APPLICATIONS

The newly developed inverse model enables researchers to quantitatively determine the rates and magnitudes of certain chemical mass transfer processes in aquatic sediments that cannot be determined through direct measurements. In general, rates are the most difficult parameters to measure directly because they cannot be determined by a static characterization.

TRANSITIONS

N/A

RELATED PROJECTS

1. Co-funded efforts by Bentley and Koretsky
2. Biogeochemistry of salt-marsh sediments, by Dr. Joel Kostka (Florida State University)

PUBLICATIONS (FY02 ONLY)

Furukawa, Y. (2001) Biogeochemical consequences of macrofauna burrow ventilation. *Geochemical Transactions*, 2, 83-91.

Viollier, E., et al. (submitted) In situ assessment of benthic biogeochemistry: State of the art technologies and guidelines for the future. *Journal of Experimental Marine Biology and Ecology* (Submitted September 2002).

Kim, J., Furukawa, Y., Daulton, T., Lavoie, D., and Newell, S., (2001) Characterization of microbially Fe(III)-reduced nontronite: Environmental cell transmission electron microscopy (EC-TEM) study. *Clays and Clay Minerals* (Submitted September 2002).