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QUANTITATIVE CHEMICAL MASS TRANSFER IN COASTAL SEDIMENTS DURING EARLY DIAGENESIS: EFFECTS OF BIOLOGICAL TRANSPORT, MINERALOGY, AND FABRIC

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LONG-TERM GOALS

The long term goals of this research are to develop a better mechanistic and quantitative understanding of the effects of biologically-enhanced transport, mineralogy, sediment fabric, and particle surface chemistry on biogeochemical reactions occurring in coastal sediments.

OBJECTIVES

Objectives for FY 1997 were to collect data for the initiation of testing of the generality of the preliminary chemical mass transfer computer model, STEADYSED1, and assessment of its sensitivity to critical parameters such as mineralogy, sedimentation rate, and organic carbon content and to design laboratory bench top reactors that will permit the decoupling of biogeochemical processes in fine-grained siliciclastic coastal sediments and quantitative analysis of the impact of biological and organic components on sediment chemical mass transfer.

APPROACH

Reactor design was researched by an exhaustive search of the biological, marine science, engineering, and hydrological literature and by contact with laboratories carrying out bench top reactor experiments. Using literature information, mineral suites which will serve as proxies for typical coastal marine sediments were identified. Literature searches were also made for field sites in which all critical input parameters needed for STEADYSED1, the presently available computer model for biogeochemical mass transfer, were available. These references and data were complied to permit a sensitivity analysis to be run on the various input parameters in the numerical model.

WORK COMPLETED

The laboratory-based experiments and reactors have been designed. Design elements permit the study of two phase flow, tidal pumping, time series extraction of pore fluids without disturbing the sediment fabric, and ability to work with sea water at different levels of filtration. Reactor systems are presently under construction. Preliminary processing of two of the five initial starting minerals has begun; and the protocol for the preparation of starting sediment mixtures and loading of the reactors is under development.

One complete set of literature data from the FOAM study in Long Island Sound has been compiled and sent to Georgia Tech. Three other sites, the Scripps Institution of Oceanography CALMAR site, Barataria Bay in Louisiana, and the Amazon delta are presently being complied.

RESULTS

Reactor design provides flexibility in the number of biogeochemical perimeters that can be decoupled in a laboratory setting.

IMPACT/APPLICATIONS

This program of integrated field, laboratory, and computer code development, focusing on quantitatively understanding the mechanisms of chemical mass transfer in marine sediments should lead to the development of a comprehensive computer model of biogeochemical mass transfer in coastal marine sediments. This predictive numerical model will be able to be applied to diverse scientific, environmental, and engineering problems involving the chemical and physical evolution of fine-grained siliciclastic marine coastal sediments.

TRANSITIONS

This project is the first phase of an ONR program that will be funded for an additional two years. One of the data sets used to test the sensitivity of computer models for biogeochemical cycling in coastal marine sediments was funded by a prior ONR grants for work on the California continental margin.

RELATED PROJECTS

A proposal has been submitted to the American Chemical Society to examine the relationship between organic matter and mineralogy in recent continental margin sediments.