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# **INFLUENCE OF CHEMICAL, PHYSICAL, BIOLOGICAL, AND GEOCHEMICAL PROCESSES OF EARLY DIAGENESIS AND MATERIAL EXCHANGE ACROSS THE SEDIMENT/SEAWATER INTERFACE IN MARGIN SEDIMENTS**

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## **LONG-TERM GOALS**

The overall goal of this project was to determine links between sediment chemistry, physical properties, and microfabric during the early diagenesis of surface and near-surface organic-rich sediments.

## **OBJECTIVES**

Objectives for FY 1997 were to synthesize and publish results of the previous two years investigation.

## **APPROACH**

Sediments were analyzed on vertical and lateral scales of millimeters to centimeters from box and gravity cores along three geologically and oceanographically distinct California continental margin transects. These analyses provided a unique, high-resolution data set for studies of biogeochemistry and physical properties in continental slope sediments. Sediment samples were augmented by marine snow collected from moored and floating sediment trap arrays.

## **WORK COMPLETED**

Microfabric data were analyzed to determine the distribution and character of organic matter as it occurs in natural sediments. Organic carbon contents and mineralogic data from the sediment cores were correlated. Statistical analysis was performed on physical property data collected in order to indicate the range in variability of geotechnical properties on millimeter, centimeter, and kilometer scales for undissected portions of the western North American continental slope. Theoretical work on smectite interlayer hydration was used to derive mathematical relations to partition the H<sub>2</sub>O in smectite-rich sediments between intergranular pore spaces and smectite interlayers. correct porosity determinations in smectite-rich sediments.

## **RESULTS**

Radiocarbon data show that a constant rate of sediment deposition over the past ~15,000 year in the study areas, except in shallow water (<400 m water depth), with sedimentation rates on the Mendocino transects being twice as fast (~10 to 70 cm kyr<sup>-1</sup>) as those on the San Luis Obispo transect.

Organic matter deposited in sediments on the California continental slope appears to occur principally as (1) discrete blebs of organic goo, (2) localized, irregular smears of undifferentiated protoplasmic or extracellular material incorporated into clay flocs, and (3) bacterial cells and their related mucopolysaccharide networks; not as thin, uniform coatings adsorbed on grain surfaces or infillings of interstices in particles with high degrees of surface roughness. Organic matter in the Mendocino area has a significant continental signature (30-50%).

Those in San Luis Obispo have continental organic matter contributions that are generally less than 15%. Neither area shows preferred preservation of organic matter to be directly correlatable to organic matter source. The organic carbon content in our samples from which discrete organic particles have been removed, appears to be controlled primarily by its association with clay minerals and other high surface area-to-volume, non-organic sediment constituents. In this regard, different clay suites appear to have different capacities for retaining organic carbon. Relations are well-behaved within a single clay mineral suite, with smectite being associated with the highest organic matter concentrations.

Physical property and pore water chemical data are time independent and were found to be a strong function of sedimentary organic matter content. Sediments with the highest porosity at the sediment-sea water interface were found to have the highest organic matter contents on all transects studied.

## **IMPACT/APPLICATIONS**

The correlation between clay mineral suite and organic carbon content has demonstrated the recently proposed monolayer theory of organic matter preservation is severely flawed. The direct observation of the textural interplay between organic matter, microbes, and clay minerals can be used to improve the design of experiments and models implemented for the purpose of identifying and monitoring processes relating to the sediment uptake and release of toxic organic-chelated compounds in the marine environment.

## **TRANSITIONS**

The data set collected for this investigation is being used to test the sensitivity of computer models for biogeochemical cycling in coastal marine sediments during early diagenesis.

## **RELATED PROJECTS**

Work has begun on the computer modeling of coastal marine sediments with ONR.

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