

SURFACE CHEMISTRY OF SOLIDS IN THE UPPER OCEAN

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

OCEANOGRAPHY

AUGUST 1995

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ABSTRACT

The surface reactions of various substrata with seawater were investigated using sophisticated surface analytical techniques. Laboratory experiments involved protein amended seawater. Field experiments involved deployment of calcite samples in a depth profile at a station in the North Pacific.

Protein adsorption was modeled after the Langmuir and Freundlich isotherms. The Langmuir isotherm fit adsorption onto metal substrates that have a thin film of respective native oxides on their surfaces. Chemically inert surfaces of Teflon (PTFE) and Pyrex followed the Freundlich isotherm. The exceptions to these two models were titanium oxide and polycarbonate surfaces that fell in between the Freundlich and Langmuir models. Conformational changes of protein structure upon adsorption were observed by Fourier Transform Infrared Reflectance-Absorbance Spectroscopy. Additionally, charge transfer resistance of surfaces was demonstrated to increase as a function of protein coverage with electrochemical impedance spectroscopy.

Carbonate mineral surface reactions were investigated with the atomic force microscope. A sampling method was developed in which samples were hung on a sediment trap array line for a three day period. Changes in the surface morphologies were examined at nanometer resolution and could be explained by the water chemistries occurring at depth.

Sample surfaces exposed in the upper two hundred meters of the oceans acquired a film. It is postulated that the film is composed of organic material adsorbed from dissolved organic matter found in surface seawater. Samples deployed deeper had dissolution features. Samples hung at 450 m and 500 m had small etch pits, and at 550 m the surfaces had rhombic etch pits similar to those observed by HILLNER *et al.* (1992). Maximum surface roughness was observed at depths between 550 m and 650 m. From the extent of acquired surface roughness the amount of calcite that had dissolved was calculated. A model was put forth which predicted the amount of calcium

carbonate that could dissolve due to the decomposition of biomass. The sedimentation flux of free coccoliths would completely dissolve between the depths of 550 and 650 m due to the measured dissolution rate.