BENTHIC FLUX AND PORE WATER MODELS OF THE UPPER SEDIMENTS OF TOMALES BAY, CALIFORNIA

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

MASTER OF SCIENCE

IN

OCEANOGRAPHY

DECEMBER 1995

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ABSTRACT

Benthic flux measurements and sediment porewater concentration profiles were used to investigate processes of organic matter degradation in the upper sediments of Tomales Bay, California. Cores 50-60 cm in length were collected in March and in July and the following constituents measured at fine-scale intervals: dissolved inorganic carbon (DIC), NH_4^+, and SO_4^{2-} concentrations; alkalinity; total organic carbon (TOC); δ^{13}C-DIC and δ^{13}C-TOC; chlorinity. Model fluxes of DIC and NH_4, and rates of SO_4 reduction and DIC production were calculated from porewater profiles. These were compared with directly measured (benthic chamber) fluxes of DIC and NH_4.

Directly measured flux varied seasonally and was generally consistent with previously reported data for these sediments. Measured flux was always significantly greater than flux modelled from porewater profiles assuming molecular diffusion alone. Flux modelled assuming increased transport due to irrigation by macrofauna resulted in generally better estimates of measured flux, suggesting that this is an important process in the upper sediments of Tomales Bay. Remaining discrepencies between measured and calculated flux values may be due to contributions by interface regeneration processes, or to inadequacies of the irrigation model.

Porewater profiles were similar to those found in other environments where an increase with depth in nutrient concentrations and a decrease in sulfate indicate degradation of organic matter by sulfate reducing bacteria. However, stoichiometric comparisons of sediment constituents revealed a severe imbalance between the amount of SO_4 reduced and the amount of DIC and NH_4 produced. Additional consumption processes for SO_4 or large sinks for DIC and NH_4 are unlikely, suggesting that sulfate concentration data is in error.

Isotopic data indicated that marine organic material is preferentially degraded over terrestrial material. Further investigation is necessary to determine seasonal or spatial trends.