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Reactive transport modeling of sediment oxygen demand in Lake Erie sediments

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A web-based, comprehensive biogeochemical reactive transport model, Biogeochemical Reaction Network Simulator (BRNS) (Regnier et al. [1], Wang and Van Cappellen [2], Van Cappellen and Wang [3], and Thullner and Aguilera [unpublished web interface]) which accounts for the oxidation of organic carbon, oxidation of secondary reduced species formed as byproducts of organic matter oxidation, the precipitation and dissolution of sulfide and carbonate minerals and the coupled redox cycles of C, O, N, S, Fe, and Mn, was applied to pore water chemical data from Lake Erie to calculate Sediment-Oxygen Demand (SOD) in each of the Lake's three basins. Lake Erie pore water data for oxygen, sulfate, nitrate, ammonium, ferrous iron, and alkalinity were determined at five stations along a longitudinal transect of Lake Erie and at 1 near-shore station in June, July and August 2002 and were fit by the model to obtain reaction rate coefficients and to calculate the flux of the ions across the sediment-water interface. Chemical concentration profiles in the sediment and the SOD are well described by the model. SOD is calculated as the net flux of oxygen across the sediment water interface and is compared to the flux of oxygen calculated from oxygen microelectrode profiles (single, uncoupled species) and to the SOD calculated from the EPA hypolimnion monitoring data.

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Hydrodynamic sorting of Washington Margin sediments using SPLITT fractionation

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SPLITT fractionation

Sieving and SPLITT (split flow thin cell) fractionation were used to hydrodynamically sort surface sediments collected along an E-W transect from the mouth of the Columbia River, across the Washington continental margin, to the Cascadia Basin in the N.E. Pacific. Sediments were separated into various coarse (>250, 100-250, 63-100, 38-63 and <38 µm) and two fine (38->1m/d and 38-<1m/d) fractions. The sieve-SPLITT method was recently tested and validated by using a variety of natural sediments [1] and results indicated that many biogeochemical processes governed by particle dynamics could be examined using this approach.

Washington Margin results

Mass distribution of sieve fractions indicates that sediments from the Washington shelf are dominated by large particles (>250 µm) whereas fine particles (<38 µm) are predominant in slope and Cascadia Basin sediments. This is consistent with the natural grain size distribution occurring in Washington margin sediments [2].

Total Organic Carbon (TOC) contents of the sediments generally follow the same distribution as the mass. With the exception of inner shelf stations, most TOC resides in the fine fraction and ranges around 1.5-3%. Stable carbon isotopic measurements on TOC indicate an increase in $\delta^{13}C$ values from the shelf to the Cascadia Basin (from -34 to -20 ‰). Consistent with this, TOC/TON ratios decrease along the same transect (from 80 to 10), suggesting a transition from terrestrial to autochthonous marine sources.

These results will be completed by those from the splittate fractions. Results of other analysis of the sieve-SPLITT fractions (inorganic elements, surface area and mineralogy) will also be presented.

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