Abstract:

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Paper I, is an intercalibration study where three benthic chambers of different design were compared with regard to their hydrodynamic properties and their capability to accurately measure benthic fluxes. Furthermore, four different methods for calculating diffusive fluxes from microelectrode profiles of oxygen in the DBL and porewater were compared. Results suggested that, although their hydrodynamic properties were clearly different, the chamber types displayed no statistically significant difference in measuring neither nutrient nor oxygen fluxes in tanks filled with homogenised sediment. One of the four methods (Berg et al., 1998) for calculating diffusive fluxes was found to be superior.

In **Paper II**, fluxes contributing to the particulate carbonate system in the deep-sea sediments of the Porcupine Abyssal Plain (NE Atlantic) were investigated over a sampling period from 1996 to 1999. Deposition fluxes were estimated from sediment trap data (mean: 0.37±0.1 mmol C m^{-2} d^{-1}) and dissolution rates (0.4±0.1 mmol C m^{-2} d^{-1}) were determined from *in-situ* benthic chamber measurements of alkalinity. The burial flux (0.66±0.1 mmol C m^{-2} d^{-1}), determined from data on the carbonate content of the sediment and sediment accumulation rates based of ^{14}C dating on foraminifera. The burial flux plus dissolution rate was three times larger than the deposition flux, indicating an imbalance in the particulate carbonate system at this locality. Results from a box model, used to estimate the response time of this system, indicated that it would take 3 kyr to reach new steady-state conditions.

The same deep-sea locality was investigated in **Paper III** but with regard to rates of degradation, recycling and burial of organic carbon (OC) and their spatial and temporal variability. Total carbonate fluxes (C_T), corrected for calcium carbonate dissolution, were used to estimate the organic carbon oxidation rates (C_{ox}; 0.46±0.37 mmol C m^{-2} d^{-1}). No statistically significant spatial or temporal variations could be detected in the C_{ox} rates during four cruises undertaken between 1996-1999. DOC fluxes (0.70±0.48 mmol C m^{-2} d^{-1}), calculated from pore water gradients, constituted an important component of OC recycling at this abyssal site. The OC burial flux (0.03±0.01mmol C m^{-2} d^{-1}), determined in the same way as for carbonate in Paper II, constituted only 2 % of the mass balance derived POC deposition rate (1.19±0.61 mmol C m^{-2} d^{-1}). The latter was significantly higher than the POC deposition rate (0.24±0.06 mmol C m^{-2} d^{-1}), estimated from sediment traps during the same period. This discrepancy could be explained by the residence time of the degradable fraction of the organic carbon pool can sustain the measured organic carbon recycling rates for up to 8 years without any new supply from the water column.

In **Paper IV**, OC recycling and burial was investigated in the continental margin sediments of the mesotrophic Skagerrak (NE North Sea) during one early spring and one late summer cruise. C_{ox} rates, estimated in the same way as in Paper III, and O_2 fluxes measured in the benthic chambers gave a mean apparent respiration ratio (C_{ox} rate/O_2 flux) of 1.21±0.45, indicating some long-term burial of reduced inorganic compounds in these sediments. Calculated diffusive DOC fluxes, compensated for the influence of biodiffusion/bioirrigation, made up 3-10 % of the C_{ox} rates and showed a significant positive correlation with the latter. Chl-*a* concentrations were measured in the sediment as an indicator of the quality of the sedimentary OC and were significantly higher in early spring compared to late summer. C_{ox} rates correlated well with the sediment Chl-*a* inventory on the respective stations, indicating that the quality of the deposited POC is an important factor regulating the recycling efficiency of OC in these sediments. Burial efficiencies from the respective stations correlated with the overall sediment accumulation rates, suggesting that this factor is important in controlling long-term preservation of OC in these sediments. Generally, burial efficiencies were high in Skagerrak sediments compared to other seas with similar sediment accumulation rates, especially in the northeastern part (~62 %), indicating that these sediments act as an efficient net sink for organic carbon.

The oligotrophic northern Aegean Sea was investigated in **Paper V** with regard to the same objectives as for the Skagerrak. A mean apparent respiration ratio of 0.90±0.36 was found which is more similar to what has previously been found in deep-sea sediments and suggesting a dominance of aerobic respiration in these sediments. In conformity with what was found in the Skagerrak, respiration rates were to a large extent controlled by the availability of labile phytodetrital organic matter. DOC fluxes were relatively more important in the Aegean compared to the Skagerrak, making up 7-27 % of the C_{ox} rate. Low sediment accumulation rates in combination with low sedimentary OC content generated burial efficiencies of similar magnitude as the deep-sea site, investigated in Paper III. This shows that OC sequestering in shelf sediments of the northern Aegean can not be considered quantitatively important in the carbon cycle of this continental margin environment.

Key words: marine sediments, organic carbon, carbonate, benthic fluxes, total carbonate (C_T), dissolved organic carbon, oxygen fluxes, burial efficiency, benthic chambers, lander, deep-sea, continental margins.

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