DECAY OF ^{14}C LABELED DIATOM DETRITUS IN "DIFFUSIVELY" MIXED VS. UNMIXED SEDIMENT

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ABSTRACT

Geochemical models and microbiological studies give conflicting predictions of the effect of bioturbation on sedimentary organic carbon decay. I use laboratory microcosms (33 ml) to investigate the effects of sediment mixing on microbial metabolic status and on the decay of buried chlorophyll *a* (chl *a*) and ^{14}C labeled diatom detritus ($PO^{14}C$) in organic-poor marine sediment. Solid-phase mixing of microcosm sediment was accomplished by the controlled motion of modified bottle brushes. Tracer-particle studies suggest that the diffusive approximation is robust for modelling moderate numbers (~100) of centimeter-scale mixing events in the microcosms. Decay of chl *a* and $PO^{14}C$ was monitored over an 80 d experiment, in which sediments were mixed at 4 rates characteristic of the abyssal ocean. Mixing promoted the balanced growth of the sedimentary microbial community, but had a non-significant effect on the decay rate of chl *a* and $PO^{14}C$. Mathematical modelling indicates that the decay of both chl *a* and $PO^{14}C$ in the microcosms is well described by equations with two types of organic matter, a highly labile fraction and a less reactive fraction. The decay rate of the labile fraction of chl *a*, or $PO^{14}C$, in the microcosms was as high as that reported for chl *a*, or POC in seawater; however, in microcosms the labile fraction constituted a much smaller proportion of total chl *a* or $PO^{14}C$. Apparently, the organic-poor sediment in microcosms preserved or stabilized a large proportion of otherwise labile chl *a* and $PO^{14}C$. These results strongly suggest that the primary effect of bioturbation on time scales <100 d is to preserve recently sedimented organic material by burying it in a "protective" sedimentary matrix. In contrast, the shift towards balanced microbial growth and the pattern of $PO^{14}C$ decay in microcosms suggest that bioturbation may enhance the decay of buried organic material over much longer times.