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# Dynamics of mineralization and sequestration of organic carbon in marine sediments.

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Particulate organic matter enters continental shelf ecosystems through riverine transport, phytoplankton production, and growth of benthic vegetation. A fraction of this organic matter is sequestered on the shelf through high Holocene sedimentation rates, while a less well-defined fraction is exported out across the continental slope. Sediment traps have measured the rain rate of particulate organic matter in the ocean, yet the calculated fluxes appear insufficient to cover the measured oxygen uptake of the global seabed. Upon burial beneath the oxic surface zone on the shelf, degradation of organic carbon continues through anaerobic mineralization, primarily by sulfate reduction, which corresponds to a third of the aerobic mineralization. In contrast, methane production contributes only a few percent of the global sediment mineralization. Experimental measurements of organic matter oxidation in the seabed demonstrate a steep decrease in mineralization rates with depth and age. Beneath the bioturbated surface sediment, power law and reactive continuum simulations of these rates constrain the power law parameters and reveal a strong similarity between the two models. Extrapolations of the power law show continuity with the oxygen uptake rate at the sediment surface and the methane production rate beneath the sulfatic zone. While terminal pathways of mineralization are controlled by upstream processes, the concentrations of key fermentation products are thermodynamically controlled within a narrow range. This is also the case for sulfate and methane in the sulfate-methane transition, although their turnover time here varies a million-fold across all ocean depths. The global mineralization of deposited organic matter is strongly skewed towards the continental shelves where an estimated 60% of benthic oxygen uptake, 66% of sulfate reduction, 75% of methane production, and 73% of organic carbon sequestration takes place.