Small-scale oxygen fluxes and remineralization in sinking aggregates

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ABSTRACT: Sinking aggregates are the major component of the vertical particulate flux in most regions of the ocean. Controlling factors for aggregate remineralization rates and solute exchange with the surrounding water, however, are poorly quantified because of few empirical data. To study the role of flow and diffusion on aggregate remineralization rates, oxygen distributions were mapped within and around aggregates by use of microelectrodes in a flow field similar to that experienced by sinking aggregates. The oxygen distribution was asymmetrical with a wake of undersaturated water at the rear (downstream) of the aggregates. Oxygen concentrations within the aggregates were >80% of air saturation. The diffusive fluxes of oxygen at the aggregate-water interface were similar along the equator and at the downstream pole for a wide range of different aggregate sources (field-sampled diatom aggregates, lab-made diatom aggregates, aggregates formed from freeze-thawed diatoms, and zooplankton detritus aggregates) measured at various temperatures. Remineralization rates were reaction limited and, hence, determined by substrate quality and quantity rather than by transport-limited oxygen supply during sedimentation at ambient oxygen concentrations above ~25 μM.

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