Are sinking or suspended particles hotspots of marine microbial nitrogen cycling?

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In the classic paradigm of marine nitrogen cycling, particulate organic matter sinks out of the sunlit surface ocean, then the organically bound nitrogen is remineralised and released as ammonium – ammonification – to fuel nitrification in the twilight to dark ocean, and replenish the immense deep-sea nitrate reservoir. In other words, sinking particles are considered as the major input of nitrogen into the deep ocean, and ammonification rates should follow the same exponenential decay trend as particle fluxes; while nitrification rates should be enhanced in sinking particles, especially in the upper twilight ocean. However, few attempts have been made to actually measure these processes. Missing also in these considerations are the non-sinking suspended particles. Recent work has revealed distinct microbial communities residing in suspended and sinking particles, thus suggesting different biogeochemical functions they confer[1]. Using marine snow catchers to distinguish particle phases into fast-, slow- and non-sinking, we measured ammonification and nitrification rates at mesopelagic depths in the Southern Ocean. We found that non-sinking fractions often gave comparable to even greater ammonification rates than sinking particles, and ammonification rate decay into the mesopelagic is far slower than expected from the classic Martin curve. Meanwhile, nitrification enhancment in sinking particles was generally insignificant. Parallel metatranscriptomic analyses further reveal stronger ammonium uptakes and assimilation, as well as protein degradation activities particularly in the suspended rather than sinking fractions. These results together indicate a much more important role in nitrogen cycling played by suspended particles than previously recognised.

[1] Duret, Lampitt, Lam (2018). *Environmental Microbiology Reports*, 10.1111/1758-2229.12692.