Seasonality of sediment- associated sulfur oxidizing bacteria in an oxygen-stressed estuary

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Cable bacteria are long filamentous microbes that act as electrical conductors in aquatic sediments providing a conduit for rapid electron transport from sulfide-generating horizons up to an oxic surface. Their unusual capacity to rapidly link electron donors with electron acceptors in sediments across centimetre-scale distances, coupled with their high affinity for sulfide, results in suboxic zones supporting high rates of sulfate reduction matched by sulfide oxidation. Additionally, by acidifying sediments, cable bacteria are capable of oxidizing sulfur present as FeS. Where they have been observed to occur abundantly, such as in marine basins suffering from seasonal anoxia, cable bacteria appear to be key players in sedimentary cryptic sulfur cycling.

In this work, we draw upon new data collected from Chesapeake Bay, focusing on the mesohaline reach which experiences seasonal low oxygen stress. We contrast sediments collected from a deep area with prolonged summer anoxia, against sediments collected from a shallower area which supports similar rates of microbial respiration but exhibits considerable sediment overturning and irrigation by infauna. At the deep site with negligible bioturbation, we find cable bacteria growth follows a predictable seasonal pattern, with the greatest densities observed in late winter. This phenology is consistent with the hypothesis that their growth is constrained by a reservoir of FeS which develops during winter. Sulfide removal by cable bacteria here has potentially profound consequences for material fluxes at the system level. At the site supporting bioturbating infauna, sulfate reduction rates are high but sulfide accumulation is negligible during most of the year. Here, we observe high densities of *Beggiatoa*-like sulfur oxidizing bacteria distributed through the upper sediment, with biomass peaking in August, together with significant quantities of cable bacteria, though with a seemingly irregular seasonal density pattern. Estimates of sulfur oxidation by *Beggiatoa* suggest these bacteria have a limited role in sulfide removal from these sediments. By extrapolating rates of biomass-specific sulfide oxidation by cable bacteria inferred from the deeper site, we find that cable bacteria at times likely play a significant role in sulfur oxidation in the bioturbated sediments. These results expand the potential quantitative importance of cable bacteria in cryptic sulfur cycling within high depositional settings.