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Nutrient turnover by large sulfur bacteria on the Namibian mud belt during the low productivity season

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The availability of nitrogen (N) and phosphorus (P) largely controls primary productivity in eastern boundary upwelling systems. Surface sediments of the coastal mud belt in the Benguela Upwelling System (BUS) off Namibia host extensive communities of chemotrophic large sulfur bacteria (LSB) dominated by *Thiomargarita* spp. and *Beggiatoa* spp. In order to understand the role of these bacteria in N and P cycling, biogeochemical data from mud belt sediments (upper 100 cm) were analyzed with a diagenetic reaction-transport model. Carbon remineralization was dominated by reduction of sulfate to hydrogen sulfide (5.0 - 7.7 mmol C m^{-2} d^{-1}). The hydrogen sulfide produced was almost quantitatively oxidized by LSB using nitrate as the electron acceptor. Rates of nitrate reduction to N_2 by LSB were over two times higher than nitrate reduction to ammonium. The resulting loss in oxidized nitrogen substrates via N_2 points toward a potential negative feedback by LSB on primary production. Furthermore, loss of fixed N strongly enriched the benthic effluxes in P relative to N. Although the model included polyphosphate uptake and breakdown by LSB, a clear link between polyphosphate dynamics and hydroxyapatite precipitation and P burial could not be clearly substantiated. Our modeling points to a significant control of LSB on benthic N to P effluxes from their surrounding sediment. Given the extremely wide coverage of LSB on the shelf (> 30,000 km^2), more accurate forecasts of nutrient cycling and primary production in the BUS necessitate a closer inspection of benthic N and P sources and sinks in the mud belt.