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Nitrogen cycling across the Peruvian oxygen minimum zone surface sediments

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Oxygen minimum zones (OMZ) are key regions for pelagic and benthic nitrogen turnover. During Meteor cruise M77 (Oct. – Dec. 2008) benthic nitrogen cycling along a latitudinal depth transect (85 to 1000 m) across the Peruvian OMZ at 11°S was studied involving in situ flux measurements, pore water geochemistry as well as diagenetic modeling. Along this transect bottom water oxygen levels were < 2 μM down to a water depth of 500 m. Below 500 m oxygen gradually increased to 40 μM at 1000 m. The Peruvian shelf and upper slope sediments which were extensively covered with sulfide oxidizing microbial mats were identified as recycling sites for dissolved inorganic nitrogen (DIN: nitrate, nitrite, ammonium) whereas sediments in the core of the OMZ and below its lower boundary represent sinks for DIN with denitrification as the major process. Anammox was of minor importance on the shelf and upper slope but was the dominant N sink at 1000 m. Mass balance calculations as well as modeling indicate that dissimilatory nitrate reduction to ammonium (DNRA) by sulfur bacteria and ammmonification were the main source pathways for ammonium to the bottom water, yielding release rates of up to 4.6 mmol m-2 d-1. DNRA retains DIN within the ecosystem and counteracts the removal of DIN via denitrification and/or anammox. This finding is in contrast to the current opinion that slope sediments in general represent major sinks for DIN.