



Effects of multiple antibiotics exposure on denitrification process in the Yangtze Estuary sediments

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Denitrification is a dominant reactive nitrogen removal pathway in most estuarine and coastal ecosystems, and plays a significant role in regulating N₂O release. Although multiple antibiotics residues are widely detected in aquatic environment, combined effects of antibiotics on denitrification remain indistinct. In this work, 5 classes of antibiotics (sulfonamides, chloramphenicols, tetracyclines, macrolides, and fluoroquinolones) were selected to conduct orthogonal experiments in order to explore their combined effects on denitrification. ¹⁵N-based denitrification and N₂O release rates were determined in the orthogonal experiments, while denitrifying functional genes were examined to illustrate the microbial mechanism of the combined antibiotics effect. Denitrification rates were inhibited by antibiotics treatments, and synergistic inhibition effect was observed for multiple antibiotics exposure. Different classes of antibiotics had different influence on N₂O release rates, but multiple antibiotics exposure mostly led to stimulatory effect. Abundances of denitrifying functional genes were inhibited by multiple antibiotics exposure due to the antimicrobial properties, and different inhibition on denitrifiers may be the major mechanism for the variations of N₂O release rates. Combined effects of antibiotics on denitrification may lead to nitrate retention and N₂O release in estuarine and coastal ecosystems, and consequently cause cascading environmental problems, such as greenhouse effects and hyper-eutrophication.