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鄱阳湖湿地沉积物反硝化空间差异及其影响因素研究

Spatial variations of denitrification in wetland sediments in Poyang Lake and the influencing factors

关键词：鄱阳湖 反硝化 沉积物 湿地

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摘要：鄱阳湖显著的水位变化导致该区域湿地类型的复杂多样，包括不同的沉积物性质及水动力条件等，这些因素势必会对反硝化速率及其途径产生影响.本研究通过对3种不同类型湿地沉积物柱样采集、流动培养及同位素添加模拟，对湿地沉积物反硝化速率的空间差异、反硝化过程及氮源等反硝化底物和沉积物呼吸等反硝化影响因素进行研究，以期进一步了解水动力变化下鄱阳湖多类型湿地沉积物的反硝化空间差异及其影响规律.结果表明，反硝化速率在水力联系较强的湖沼沉积物中最高，达到（43.98±2.33）μmol·m^{-2}·h^{-1}；在洲滩沉积物中次之，为（35.36±6.12）μmol·m^{-2}·h^{-1}；而与大湖区连通性较弱的内湾湖沼沉积物中最低，为（13.45±3.21）μmol·m^{-2}·h^{-1}.不论是洲滩沉积物还是不同水力联系下的湖沼沉积物，总反硝化速率与上覆水硝酸盐之间均存在显著正相关（p<0.01），表明上覆水硝酸盐是反硝化的限制性因子.相关分析显示，不同湖区沉积物的呼吸速率及微生物有机碳（Microbial biomass carbon，MBC）含量对鄱阳湖湿地沉积物反硝化也具有一定的影响（p均为0.05）.在两种反硝化途径中，洲滩和不同水力联系下湖沼沉积物中以水体硝酸盐为底物的非耦合反硝化均强于耦合反硝化，说明非耦合反硝化是反硝化的主要方式.耦合反硝化与非耦合反硝化在内湾区湖沼沉积物中均较弱；与大湖区连通的湖沼沉积物的非耦合反硝化强于洲滩沉积物，说明反硝化途径与水力联系及沉积物有机质水平具有一定的联系.

Abstract：The significant water fluctuation in Poyang Lake contributes to the diversity of wetlands, including different properties of sediment and hydraulic conditions, which influence denitrification rate and processes. In this study, sediment columns were collected from three different wetland, and flow incubation experiment that combined N-15 isotope pairing technology (IPT) were conducted to investigate spatial variations of denitrification rates, denitrification processes as well as the possible influencing factors such as nitrogen source and sediment respiration and to understand the effect of hydraulic changes on denitrification in the sediment of Poyang Lake. The marsh sediment in the open lake with the strongest hydraulic connection had the highest denitrification rate ((43.98±2.33) μmol·m^{-2}·h^{-1}), followed by bottomland sediment((35.36±6.12) μmol·m^{-2}·h^{-1}) and marsh sediment in the bay ((13.45±3.21) μmol·m^{-2}·h^{-1}). The total denitrification rate had a significant positive correlation with nitrate in overlying water (p<0.01) either in bottomland sediment or in marsh sediment, which meant that nitrogen source was the limiting factor of denitrification. Correlation analysis showed that sludge oxygen demand (SOD) and microbial biomass carbon (MBC) had certain influence on the denitrification in wetland sediment (p=0.05, p=0.05). From the point of the denitrification processes, uncoupled denitrification was stronger than coupled denitrification in all three kinds of sediments, which suggested that uncoupled denitrification was the main denitrification process. The coupled denitrification and uncoupled denitrification in the bay were both very low compared with the other 2 sites. In the open lake, uncoupled denitrification in marsh sediment was stronger than in bottomland sediment, which suggested that denitrification process had certain relationship with the hydraulic connection and organic matter in sediment.

Key words：Poyang Lake denitrification wetland sediment