Chemodenitrification: an important route to emit greenhouse gas N_2O under anoxic conditions

CHEN DANDAN[123], LIU TONGXU[1]*, LI FANGBAI[1]*, ZHAO WENQI[1]

[1]Guangdong Institute of Eco-Environmental Science & Technology, Guangzhou 510650, China, txliu@soil.gd.cn

[2]Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China

[3]University of Chinese Academy of Sciences, Beijing 100049, China

Nitrous oxide (N_2O), as a potent greenhouse gas, is about 200 times more effective at absorbing long-wave radiation than carbon dioxide (CO_2). Many studies have focused on N_2O production processes, including nitrification and denitrification mediated by microbes and fungi. Chemodenitrification, an abiotic reaction between NO_x^- and Fe(II) at anoxic conditions, is another significant source of natural N_2O emission and plays a crucial role in coupling of F and N cycles. While numerous studies have been conducted, the comprehensive understanding of chemodenitrification under various conditions is still lacking. In this study, the effects of pH and temperature on chemodenitrification have been studied. The rates of Fe(II) oxidation, nitrite reduction and N_2O production were greatly enhanced with the increase of pH from 5.5 to 7.0. However, no great changes of the rates were observed at pH 7.0-8.0. The formed minerals from Fe(II) oxidation were characterized. Only goethite was observed at pH 5.5-7.0, but an obvious mineral transformation was observed under alkaline condition (pH 7.0-8.0). In the first 12 hours, only green rust was formed; after 24 hours, green rust decreased while goethite and lepidocrocite increased; after 48 hours, all green rust disappeared, which might be transformed into goethite, lepidocrocite and magnetite. The temperature (from 5 to 30 °C) also had a substantial effect on chemodenitrification. The rates of Fe(II) oxidation and nitrite reduction increased significantly with the rise of temperature. Moreover, the yield of N_2O with high temperature was obviously more than that at low temperature. This study provides an improved understanding of the relationship between the emit of greenhouse gas N_2O by chemodenitrification and two important environment parameters, pH and temperature.

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