（様式 5）

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学位（博士）論文要旨

(Doctoral thesis abstract)

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論 文 題 目 (Title)	Characterizations and mechanisms of methane and nitrous oxide emissions in shallow lakes

論文要旨（2000 字程度）
(Abstract(400 words))
※欧文・和文どちらでもよい。但し、和文の場合は英訳を付すこと。
（in English or in Japanese)

Shallow lakes are considered important contributors to emissions of methane (CH_4) and nitrous oxide (N_2O), powerful greenhouse gases, in aquatic ecosystems. There is uncertainty regarding the relationship between CH_4 and N_2O emissions and the lake eutrophication progress. CH_4 and N_2O fluxes in different lakes along a trophic state gradient in the Yangtze River basin were studied. Meanwhile, the biokinetics of N_2O consumption were elucidated for understanding the effects of temperature and oxygen on N_2O consumption.

Mean CH_4 fluxes from different trophic state lakes were 0.1–130.4 mg m^{-2} h^{-1}. The CH_4 flux ranged widely and was positively correlated with the degree of eutrophication. Results indicated that CH_4 fluxes could be well-predicted by the NH_4^+ in the water column, as both NH_4^+ and CH_4 were produced during mineralisation of labile organic matter. The non-linear model can be explained the difference of CH_4 fluxes in the lake trophic state for shifting from mesotrophic to hyper-eutrophic states. Due to the algal accumulation, the hypereutrophic lakes functioned as CH_4 emission hotspots.

N_2O fluxes were –1.0–53.0 μg m^{-2} h^{-1} and 0.4–102.9 μg m^{-2} h^{-1} in summer and winter, respectively. The non-linear exponential model explained differences in N_2O fluxes by the degree of eutrophication. Results underlined that algal decomposition controls denitrification by altering redox conditions, and excess algal accumulation compromises denitrification because the supply of nitrate from nitrification is limited, thereby delaying the N_2O emission. Such cascading events explained the higher N_2O fluxes in winter compared with summer. This trend was amplified in hyper-eutrophic shallow lakes after algal disappearance.

Given that temperature and oxygen are the key factors for regulating N_2O emission, we also explores the effects of temperature and oxygen on biokinetics of pure culture N_2O-reducing bacteria (N_2ORB). The higher activation energy for N_2O by *Azospira* sp. strain I13 compared with the other tested N_2ORB indicates that N_2ORB can adapt to different temperatures. The O_2 inhibition constants of

Azospira sp. strain I09 and *Ps. stutzeri* JCM5965 displayed increasing tendency, as the temperature increased from 15°C to 35°C, while that of *Azospira* sp. strain I13 was temperature-independent. Within the range of temperatures examined, *Azospira* sp. strain I13 had a faster recovery after O_2 exposure compared with *Azospira* sp. strain I09 and *Ps. stutzeri* JCM5965. These results suggest that temperature and O_2 exposure result in the growth of ecophysiologically distinct N_2ORB as N_2O sinks.

（英訳）※和文要旨の場合(400 words)