# Paleo-phosphorus loading to Lake Biwa in Japan anterior to the urban-industrial activity

K. TOYODA

Grad. Sch. Environ. Earth Sci., Hokkaido Univ., Sapporo, Japan (kazuhiro@ees.hokudai.ac.jp)

Lake Biwa is Japan's biggest lake and it is providing abundant source of water for 14 million people. Lake Biwa was oligotrophic before modern anthropogenic contamination. Phosphorus overloading is ultimate trigger for the eutrophication. Since many movements for the prevention of eutrophication in Lake Biwa have been developed, the estimated value of phosphorus loading to the lake anterior to the urban-industrial activity should be essential to the environmental politics.

Chemical characterization of piston-core samples from 21 sites in the lake was performed. The strong positive correlation between phosphorous content in the surface sediment and the water depth of the sites is found. As total-P content, bulk density, sedimentation rate and area-distribution are the functions of the depth of the site in Lake Biwa, the phosphorous loading to the lake 100–200 years ago was estimated in this study. The result is preliminarily ca.0.8 $gPm^{-2}y^{-1}$ and the value is unexpectedly within the range of eutrophic lake from the Vollenweider (1968) plot.

Incidentally, recent phosphorous loading to Lake Biwa is reported as 1.3-1.6 $gPm^{-2}y^{-1}$ after 1990, which is significantly heavier value from present observation. These discrepancies are considered to be due to large scale scavenging of phosphorous to the profound lake-floor. This phenomenon is specific to the lake and is probably because it is one of the oldest lakes in the world.

It is reported that the uppermost sediment was so oxidized that the P loading to the lake could be estimated to some extent. As global warming will progress certainly, the relationship between climatic change and P loading values to the lake should be important. Vertical distribution of P contents in two piston cores from the profound area of the lake was measured in this study. The changes appear to roughly correspond with climactic change (Hypsithermal and Last Glacial Maximum) with some time-lag.

**Reference**

Vollenweider R.A. (1968) Tec.Rept. DAS/CSJ/68.27.OECD

# Fractionation of $N_2O$ isotopomers during production by denitrifiers

S. TOYODA[1,5], H. MUTOBE[2], H. YAMAGISHI[2], N. YOSHIDA[1,2,3,5], AND Y. TANJI[4]

[1]Department of Environmental Chemistry and Engineering, Tokyo Institute of Technology (stoyoda@chemenv.titech.ac.jp)
[2]Department of Environmental Science and Technology, Tokyo Institute of Technology
[3]Frontier Collaborative Research Center, Tokyo Institute of Technology (naoyoshi@depe.titech.ac.jp)
[4]Department of Bioengineering, Tokyo Institute of Technology (ytanji@bio.titech.ac.jp)
[5]Also with SORST project, Japan Science and Technology corporation

Nitrous oxide ($N_2O$) is one of the greenhouse gases increasing in the atmosphere and also plays an important role in the stratospheric chemistry concerning ozone depletion. Microbial production in natural and fertilized soils is estimated to be the largest source of $N_2O$ on the earth's surface, but its magnitude and relative contributions of production processes such as nitrification and denitrification have not been well understood.

Isotopomer ratios of $N_2O$, intramolecular $^{15}N$-site preference as well as conventional isotope ratios for N and O in NNO (we designate $N^{\alpha}$ and $N^{\beta}$ for the center and end N atom, respectively, in the asymmetric molecule), reflect the production and consumption processes of the gas and thus are useful parameters for deducing the global $N_2O$ budget. Here we present the first measurement on $^{15}N$-site preference in $N_2O$ produced by two species of denitrifying bacteria.

Cultures of *Pseudomonas fluorescens* (ATCC 13525) and *Paracoccus denitrificans* (ATCC 17741) grown on solidified nutrient broth medium under $CO_2$ atmosphere were inoculated to batches of flasks containing 100 ml of Giltay's liquid medium, which contains $KNO_3$ as unique nitrogen supply, and incubated under acetylene/helium (10% v/v) atmosphere at 27°C. Time course of $N_2O$ production and its isotopomer ratios were obtained by sampling the gas phase of each flask at appropriate time intervals and using a GC-ECD and GC/IRMS modified for mass analysis of fragment ions of $N_2O$ ($NO^+$) for the determination of isotopomers.

Up to 40% of the nitrate in initial medium (0.1 or 0.01 M) was consumed during the incubation experiments and the yield of $N_2O$ ranged from 0.01 to 60% depending on initial [$NO_3^-$] and bacterial species. Fractionation factors for $^{15}N$ in bulk nitrogen in $N_2O$ (average for $N^{\alpha}$ and $N^{\beta}$) fluctuated in a few tens permil, showing weak dependence on species, although they are in the range of previously reported values for several denitrifiers. In contrast, $^{15}N$-site preference (difference in isotope ratios between $N^{\alpha}$ and $N^{\beta}$) showed nearly constant and distinct value for the two species. These results and those recently reported for nitrifying bacteria suggest the $^{15}N$-site preference in $N_2O$ can be used to identify the production processes of $N_2O$ on the level of bacterial species or enzymes involved.