AOGS 2005

Estimation of production/respiration in Lake Biwa by stable isotope ratio of dissolved oxygen and oxygen consumption rate

ICHIRO TAYASU[1], CHIKAGE YOSHIMIZU[2], EITARO WADA[3] and TOSHI NAGATA[1]
[1]*Center for Ecological Research, Kyoto University*
[2]*Japan Science and Technology Agency*
[3]*Ecosystem Change Program, Frontier Research Center for Global Change*

Dissolved oxygen (DO) is essential to the metabolism of all aerobic aquatic organisms, and its dynamics are obviously important for aquatic ecosystems. Lake Biwa, the largest lake in Japan, is a warm monomictic lake. DO is at a maximum in late winter after overturning occurs in the lake. DO in hypolimnion decreases toward the end of stratification period, late autumn or early winter. The depletion of DO in hypolimnion is strongly affected by both the intensity of stratification and the consumption of organic matter. $\delta^{18}O$ of dissolved oxygen is affected primarily by air-water gas exchange, photosynthesis and respiration [1]. Gas exchange drives $\delta^{18}O_{SMOW}$ of DO toward 24.2‰, while photosynthesis produces oxygen with the $\delta^{18}O$ of lake water (-6.7‰ in Lake Biwa [2]). Respiration discriminates $\delta^{18}O$ of oxygen by ~20‰, whereby causing the enrichment of ^{18}O in DO.

We have monthly sampled dissolved oxygen from surface (10m) to the bottom (about 70m) in 2004. Apparent oxygen consumption rate at the bottom was 20μg/l/day on average in stratification period. In circulation period, difference in $\delta^{18}O$ of DO from surface to the bottom was small and $\delta^{18}O$ of DO was slightly lower than that in air-equilibrated water, indicating the production dominance over respiration. In summer, $\delta^{18}O$ of DO in epilimnion was lower than that in air-equilibrated water, indicating the dominance of biological production by photosynthesis, whereas $\delta^{18}O$ of DO in hypolimnion was higher than that in air-equilibrated water, indicating the respiration dominated system. $\delta^{18}O$ of DO at the bottom exceeded 30‰ in late stratification period. Using the $\delta^{18}O$ of DO and oxygen consumption rate, we estimated the seasonal change of production/respiration in Lake Biwa.

References

[1] P.D. Quay *et al., Limnol. Oceanogr.* **40**, 718 (1995)
[2] M. Taniguchi *et al., Hydrol. Processes* **14**, 539 (2000)