35 Years of Diversity
– Stable Isotope Geochemistry, Volcano-Fluid Interaction, and Geochemistry Linked to Mitigation of Natural Disasters –

Minoru Kusakabe
Institute for Study of the Earth's Interior, Okayama University
Misasa, Tottori-ken 682-0193, Japan
E-mail: Kusakabe@misasa.okayama-u.ac.jp

I started my career as a geochemist 35 years ago, initially studying chemical behavior of volcanic gases from some Japanese volcanoes, followed by experimental work on isotope fractionation of some light elements such as oxygen and sulfur (e.g., Kusakabe and Robinson, 1977). The latter was later applied to the studies of volcano-fluid interaction. The Lake Nyos gas disaster in 1986 made a turning point in my career. At that time, the view that a volcanic eruption caused the gas disaster was widely circulated in the mass media. The Japanese Government asked me, as a volcanic gas geochemist and as a member of the Japanese disaster relief team, to investigate what happened at the lake. In the field I had an intuition that the disaster was caused by a process related to the lake. Since then, I continued a geochemical survey together with my Japanese colleagues and Cameroonian and American scientists. We found that Lakes Nyos and Monoun (where a similar but smaller scale gas disaster had taken place in 1984) were charged by a natural input of magmatic CO_2 from the bottom of the lakes. Recharge of CO_2 resulted in an increase of the total amount of dissolved CO_2 at an alarming rate after the gas burst at L. Nyos (Fig. 1). A similar observation has been obtained for L. Monoun.

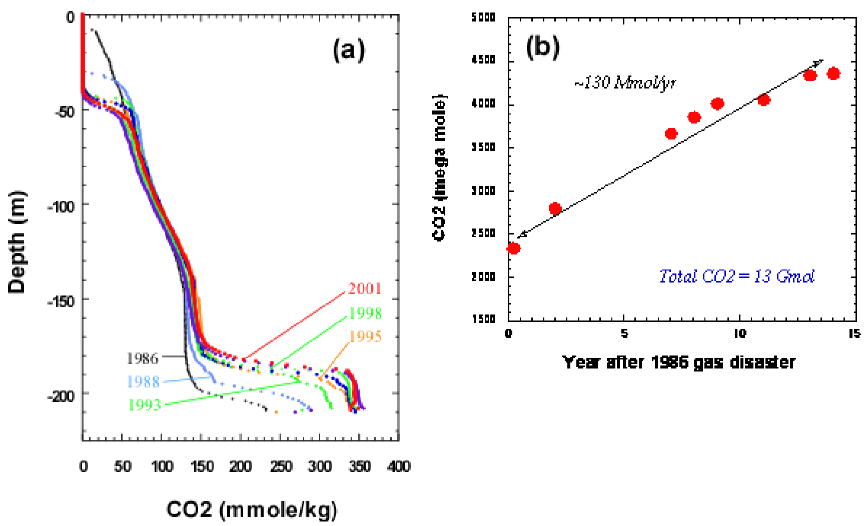

Fig. 1. Pre-degassing evolution of CO_2 profiles (left) and the amount of dissolved CO_2 below 170 m (right) as a function of time at Lake Nyos. Recharge rate is ~130 mega-mole CO_2/year.

Funded mainly by OFDA (USAID), one degassing pipe each was installed at Lake Nyos in 2001 and at Lake Monoun in 2003, to remove the dissolved gases in a controlled manner (Halbwachs, 2004). So far degassing has gone on without inducing any change in the stability of the lakes as opposed to initial concerns that it was going to induce lake instability. The total amount of dissolved gases in these lakes is now steadily decreasing, indicating that an impending threat of gas explosion, especially at L. Monoun, has decreased. Based on simple mass balance calculations on the CO_2 inventory of each lake, a future prospect on the total amount of dissolved CO_2 has been made as shown in Fig. 2 (Kling et al., 2005).

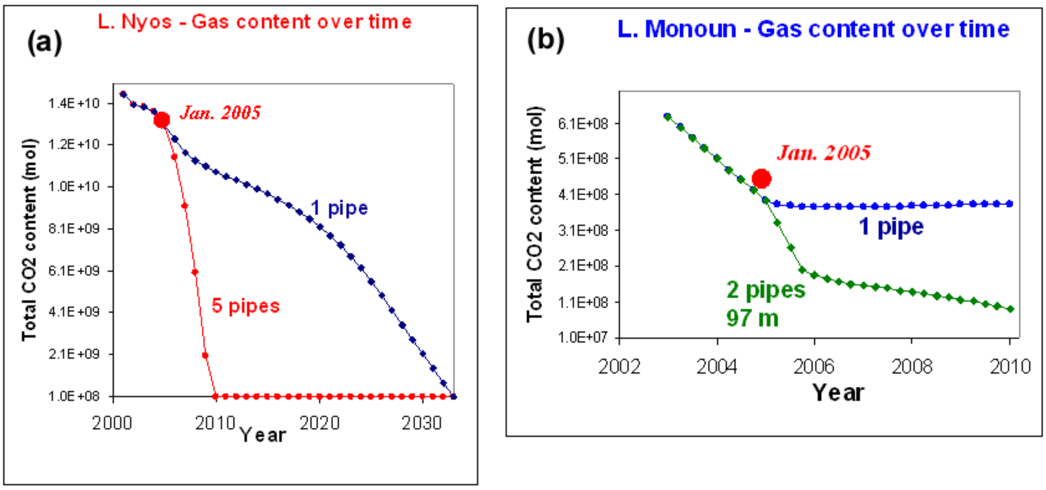

Fig. 2. Model calculations of the change with time in the amount of dissolved CO_2 in Lakes Nyos (left) and Monoun (right) (Kling et al., 2005). Solid circles indicate observed values in January 2005 (unpublished data).

It will take more than 30 years to degas Lake Nyos almost completely with a single pipe, so additional pipe installation is required to make the lake safe within several years (Fig. 2a). The amount of CO_2 in Lake Monoun will become steady very shortly because of the high recharge rate of CO_2 relative to the removal rate through a single pipe (Fig. 2b). Presently two more pipes are being installed at L. Monoun, which will certainly accelerate the gas removal in a reasonable period of time.

After 35 years of diversity, I will come back to classic stable isotope geochemistry, especially to the ^{16}O-^{17}O-^{18}O systematics of extraterrestrial materials as initiated by Prof. Clayton some 35 years ago.

References

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