Current status of Lakes Nyos and Monoun, Cameroon

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Warnings have been repeatedly issued for a potential recurrence of the limnic eruption in the near future at Lakes Nyos and Monoun (Cameroon), because the amount of CO_2 dissolved in the lakes is increasing at an alarming rate. At the same time a recommendation has been presented that the gases should be removed (Freeth et al., 1990, Kling et al. 1994, Evans et al., 1994, Kusakabe, 1996, Kusakabe et al., 2000). Following the successful degassing experiments at Lake Monoun in 1992 (Halbwachs et al., 1993) and at Lake Nyos in 1995 (Halbwachs' home page, 2001, http://perso.wanadoo.fr/mhalb/nyos/), a permanent degassing apparatus was put in place at Lake Nyos in February 2001 and at Lake Monoun in February 2003 as part of the Nyos-Monoun Degassing Project (NMDP) using the funds supplied mainly by the Office of Foreign Disaster Assistance under USAID. For more information on the technical aspects of the degassing apparatus see Halbwachs' home page. In this note the current status of the lakes (as of January 2003) is briefly presented.

The amount of CO_2 accumulated in Lake Nyos is shown in Fig. 1 as a function of time after the 1986 limnic eruption took place. The accumulation rate was almost constant at 180 mega-mole/year for the first 10 years (1986-1996), and slowed down to 70 mega-mole/year after April 1996. After January 2001 when the permanent degassing started, the amount of dissolved CO_2 has been decreasing, as expected, at a rate of ~100 mega-mole/year. Assuming the natural recharge rate to be 70 mega-mole/year after January 2001, the net degassing rate is estimated to be 170 mega-mole/year. Because the degassing apparatus has been working on and off since 2001 (Fig. 2), the above degassing rate represents an average value for the last 2 years.

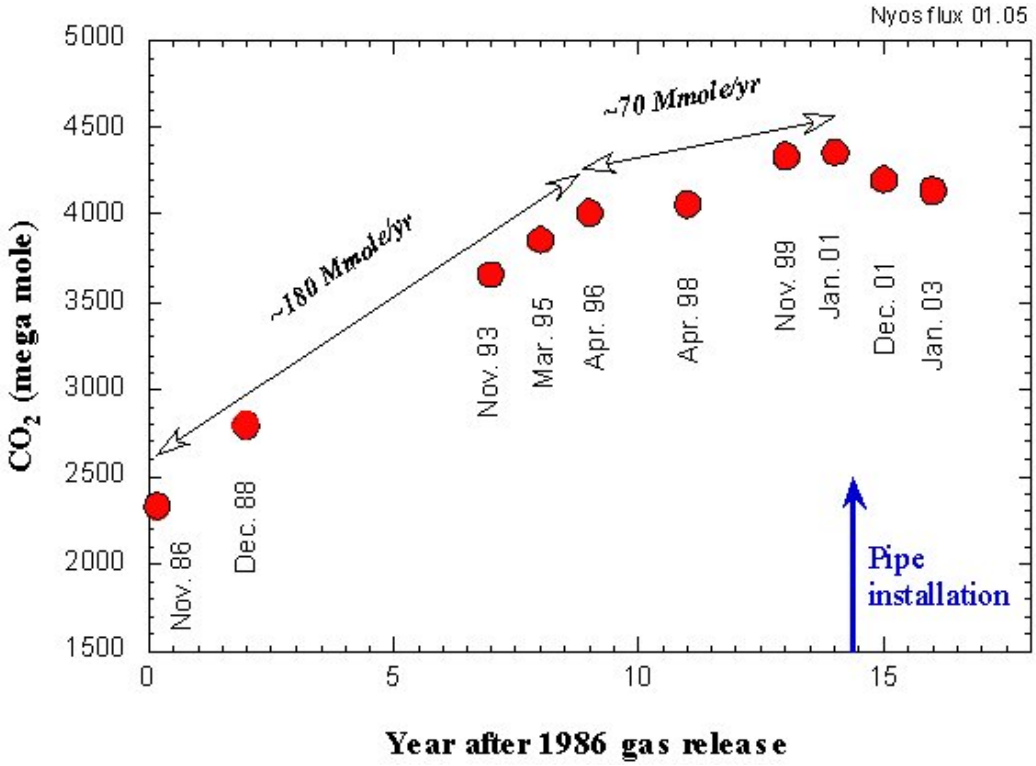

Figure 1: The rate of CO_2 accumulation below 175 m at Lake Nyos since 1986.

(a) Big jet, January 2001 (b) Reduced jet, January 2003

Figure 2: Degassing at Lake Nyos.If the apparatus were fully functional until now with a degassing rate of 900 mega-mole/year as initially estimated by Halbwachs (2001), the

total amount of dissolved CO_2 would have reduced to half of the pre-degassing level in 7~8 years (Fig. 3). It is obvious that the current degassing rate is not large enough to clean the lake within a reasonable period of time, say, 5 years. More degassing apparatus are definitely required to achieve complete degassing. The degassing apparatus should be robust and endurable under the tropical conditions that may weather the apparatus easily.

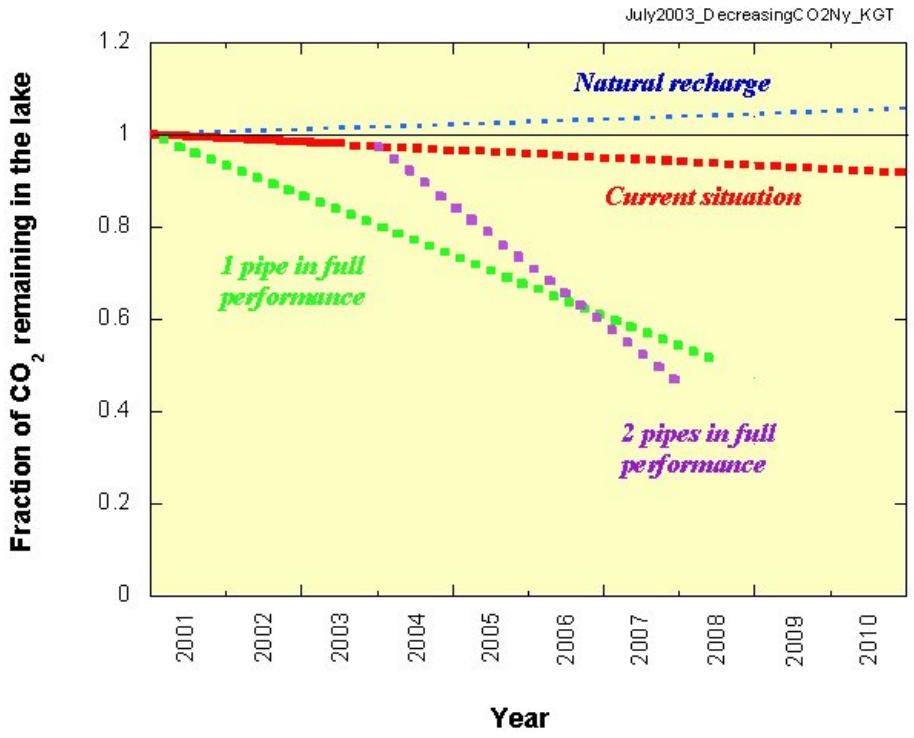

Figure 3: Prospect of degassing. The pre-degassing CO2 level was taken as a reference. Estimates are shown for the current system (red curve), 1 full functional pipe (green), and 2 functional pipes starting 2004 (purple).

The effect of 2 years of degassing on the chemical structure of the lake is shown in Fig. 4. In the upper water column the electrical conductivity has increased from January 2001 until January 2003 (Fig. 4a). The shallow chemocline (~50 m depth) has deepened by several meters and sharpened. The increased conductivity in the epilimnion could be due to either deeper mixing which entrained salts from depths greater than 50 m, or to inputs of salty bottom water brought to the surface in the degassing pipe. Between 175-190 m we observed subsidence by a few meters of conductivity (Fig. 4b) and CO_2 (Fig. 4c) profiles, with the shape of the profiles almost unchanged. This indicates no disturbance in the hypolimnion by the degassing operation, and removal of gas and salts

from the degassing pipe with an intake depth at 203 m.

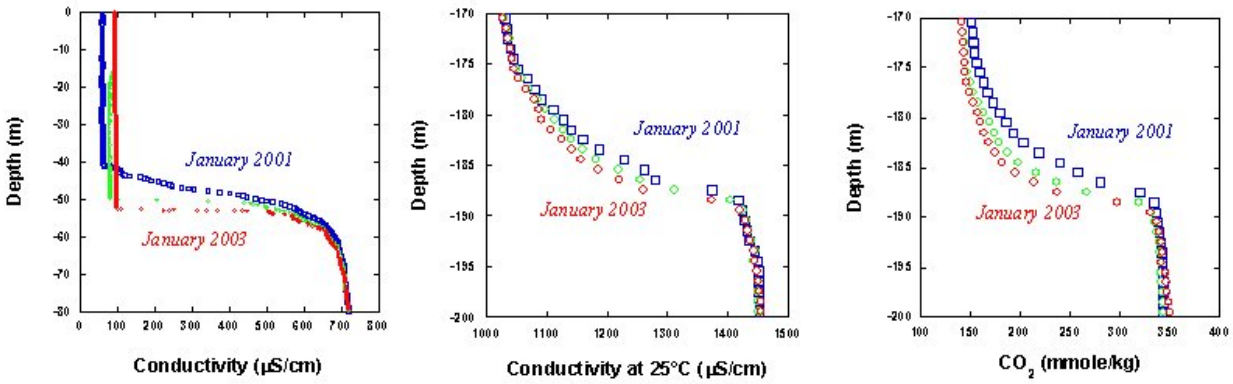

Figure 4. Effect of degassing on Nyos water.

The amount of CO_2 accumulated at Lake Monoun is shown in Fig. 5 as a function of time since 1984. The accumulation rate is estimated to be ~10 mega-mole/year. At Lake Monoun CO_2 is mostly dissolved below 55 m with a constant concentration of 160 mmole/kg through to the bottom. If the CO_2 accumulation rate estimated above is unchanged, the lake would be saturated with CO_2 at 55 m depth within ~5 years, leading to a spontaneous gas release. In this respect Lake Monoun is highly dangerous. It was fortunate that installation of a permanent degassing system was made in February 2003 (Fig. 6). Since the degassing apparatus has been working continuously, a decrease in the CO_2 level at 55 m depth is expected as was seen for Lake Nyos. Because of the large amounts of gas still dissolved in these two lakes, the danger from another gas burst is high until gas is removed. More degassing pipes should be installed as soon as possible.

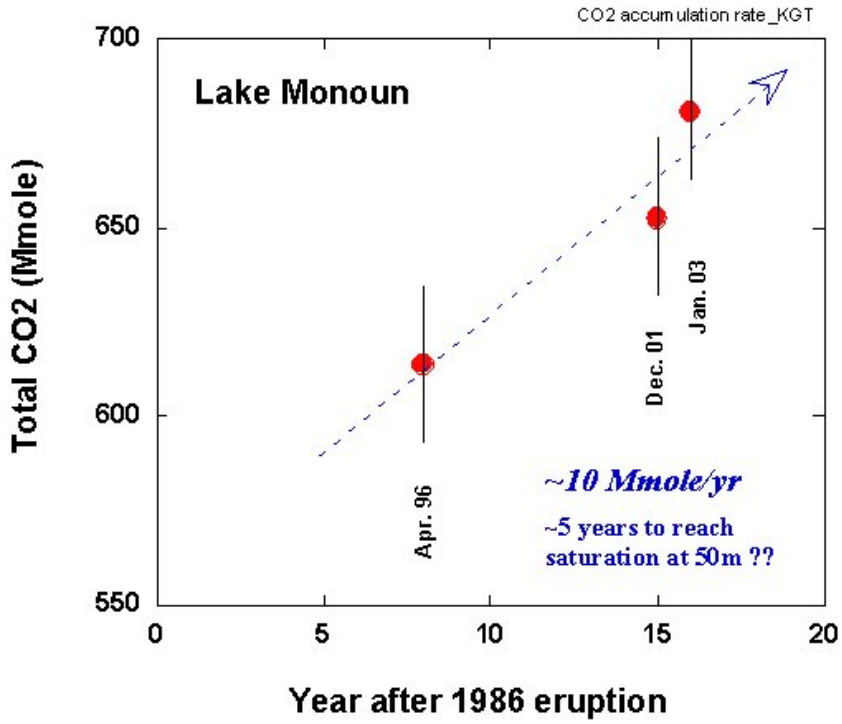

Figure 5. CO_2 accumulation rate at Lake Monoun

Figure 6. Degassing Lake Monoun, February 2003

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