

## Installation of a solar power-driven deep water removal system at Lake Monoun

### Background

The first degassing pipes were installed in Lakes Nyos and Monoun in 2001 and 2003, respectively. In later years, additional degassing pipes were installed at both lakes. The degassing worked well, and the amount of CO<sub>2</sub> dissolved in the lakes decreased with time. Decrease in CO<sub>2</sub> concentration in bottom water made an activity of the degassing system weak, resulting in lowering of the fountain height. At Lake Monoun, the degassing finally ceased in 2011.

It has been observed that CO<sub>2</sub>-rich fluid is still continuously added to the lake bottom at Lake Monoun. This implies that re-buildup of gas would resume in the lake bottom, for no more degassing is expected. The current situation at Lake Monoun is shown in Figure 1 which indicates gas re-buildup has started. The same situation would be realized at Lake Nyos in the near future after degassing ceases.

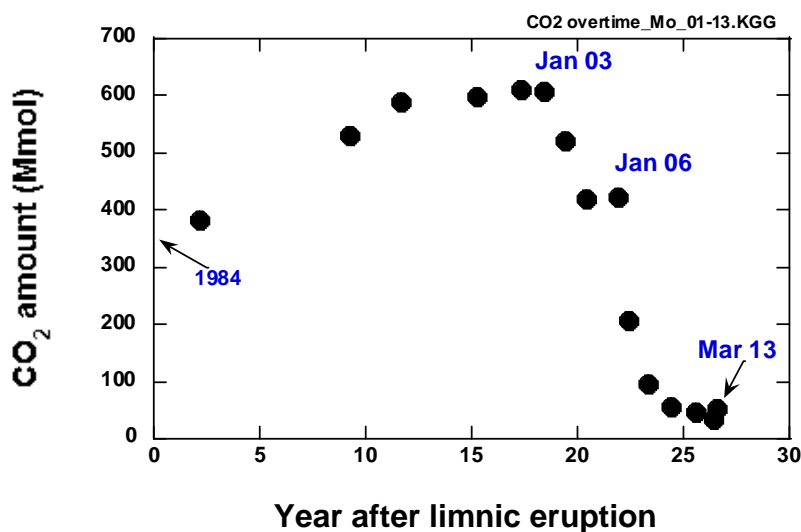


Fig. 1. Change with time in the amount of CO<sub>2</sub> dissolved in Lake Monoun. Note a slight increase of the dissolved CO<sub>2</sub> amount in March 2013.

### Setup of the solar power-driven deep water removal system

Three degassing pipes still remain at Lake Monoun even after cessation of gas self-lifting. One of the degassing pipes (C2) kept working until 2011 and we were able to see a bubbly flow coming out of the mouth. It completely stopped working in March 2012. To our surprise,

however, the pipe *revived* and we saw a mini-fountain of bubbly flow with a height of 40 cm from the lake level (Fig. 2).



Fig. 2 A mini-fountain of bubbly flow at Lake Monoun, December 2013.

We newly constructed a raft and set 4 solar panels on top of the raft (Fig. 3). The raft was attached to the existing raft that held a pipe with the bubbly flow. The solar panel has a maximum power of 320 W. A helical pump was inserted into the pipe to a depth of approximately 10 m. We confirmed that the solar power-driven deep water removal system started working as planned (Fig. 4).

It is important to determine the bottom gas concentration and a CO<sub>2</sub> profile of the lake in the near future to check any change in CO<sub>2</sub> content (the measurement shall likely be done in February-March 2014). With this system, we hope we can continuously remove CO<sub>2</sub>-rich bottom water out of the lake for a long period of time. This system can be applied to Lake Nyos after cessation of gas self-lifting of all degassing pipes there.



Fig. 3. A new raft with solar panels.



Fig. 4. The pump system in operation.

### Work log

- 9<sup>th</sup> December 2013: Y. Yoshida and M. Kusakabe arrived at Yaounde in late evening.
- 10<sup>th</sup> December 2013: YY and MK visited the Nkolbisson laboratory to pick up some materials necessary for the field work.
- 11<sup>th</sup> December 2013: YY, MK and Djomou moved from Yaounde to Foubot. Stayed at Hotel du Stade.
- 12<sup>th</sup> December 2013: All the materials necessary for the system had already been delivered to Lake Monoun by IRGM, which made our construction work go very smoothly. A new raft for setting up the solar panels was constructed (Fig. 5). Four solar panels were attached. The raft was towed and attached to the existing raft.
- 13<sup>th</sup> December 2013: The helical pump was inserted into the pipe from which a bubbly flow was coming out. The pump was connected to the solar panels, and started working. Greg Tanyileke and A. Inaba joined.
- 14<sup>th</sup> December 2013: We confirmed the performance of the system. We reported our work and its purpose to the chief of Jindoun village. Then we returned to Yaounde.
- 15<sup>th</sup> December 2013: The mission report was prepared.
- 16<sup>th</sup> December 2014: We visited IRGM, and discussed about the plan for the next field work.
- 17<sup>th</sup> December 2014: We visited the JICA Yaounde office to report the achievement of this trip. Y. Yoshida and M. Kusakabe left Yaounde for Japan.



Fig. 5. A group photo taken after construction of the new raft with solar panels.