Mission report of “CO_2 supply-system-study team” on survey at Lakes Nyos and Monoun in March 2014

Kazuto SAIKI (Osaka Univ.)
Katsuya KANEKO (Kyoto Univ.)
Romaric NTCHANTCHO (IRGM)
Alain FOUEPE (IRGM)

The field survey was performed between 28th February and 2nd March at Lake Nyos, and 4th and 5th March 2014 at lake Monoun. We performed four kinds of activities as follows.

Activities

1. Measurement of sound velocity profile at Lakes Nyos and Monoun
2. Measurement of the CO_2 flux from soil and the surface of Lakes Nyos and Monoun
3. Photography and colorimetry of the bottom of the lakes by an underwater camera with pressure container
4. Bathymetry of Lake Monoun using a GPS SONAR.

Results

1. Measurement of sound velocity profile at Lakes Nyos and Monoun

Measurement of vertical profiles of sound velocity was performed at 9 points at Lake Nyos and 6 points at Lake Monoun by a sound velocity profiler MinosX (AML Oceanography). Representative profiles of the sound velocity measurement are shown in figures 1 and 2 with the data in 2012. The results at Lake Nyos indicate that (1) there was no change in the profiles regardless the measuring points and (2) the thickness of high CO_2 concentration layer at the bottom had reduced in comparison with the profile in 2012. The results at Lake Monoun indicate that (1) the sound velocity profiles at Lake Monoun are different between the central and eastern basins and (2) both profiles had slightly changed from 2012 but the depths where the profile branches are almost the same between the data in 2012 and 2014.

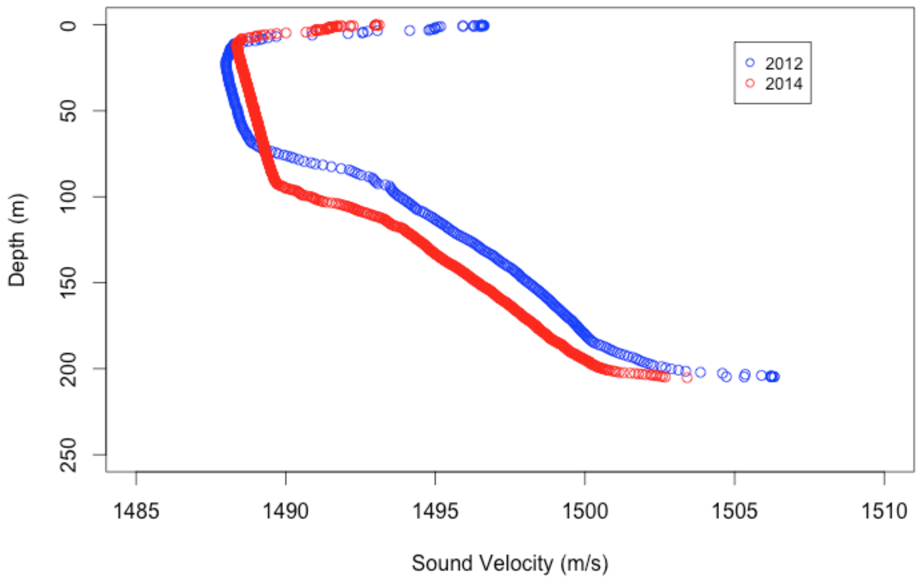

Figure 1. Representative profiles of sound velocity in 2012 and 2014 survey at Nyos.

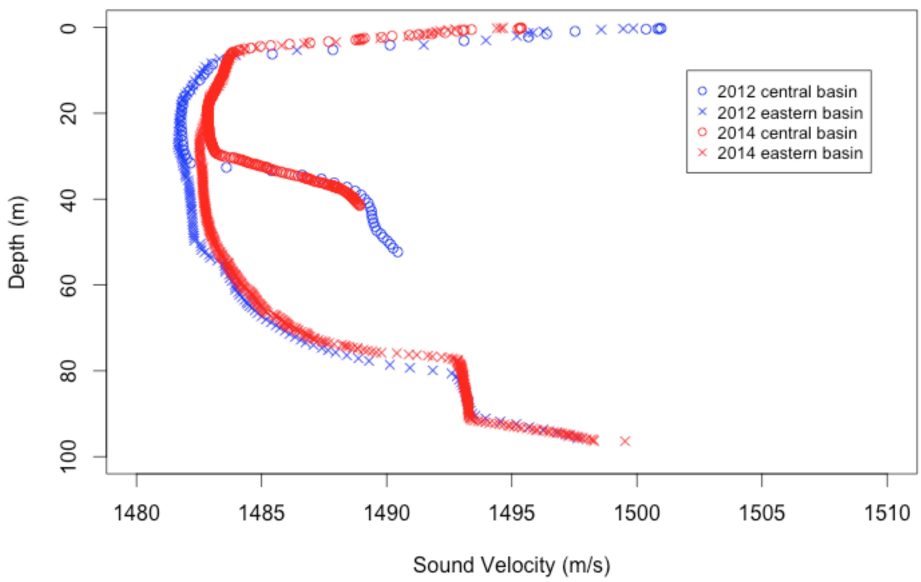

Figure 2. Representative profiles of sound velocity in 2012 and 2014 survey at Monoun. The circles are measurements at the central basin and the crosses are measurements at the eastern basin.

2. Measurement of the CO_2 flux from soil and the surface of Lakes Nyos and Monoun

We measured diffusive CO_2 fluxes from lake and ground surfaces in order to understand manners of CO_2 emission and transport at Lakes Nyos and Monoun. We used a device consisting of LI-COR LI820 CO_2 Analyzer and chamber sealed from the ambient air (Photo1, Fig. 3). They are connected with plastic tubes and a pump and the air in the device is circulated between the chamber and CO_2 gas analyzer. The CO_2 content of the air in the device increases by CO_2 flux from the surface with time and are measured by the CO_2 gas analyzer. On the basis of this temporal change of the CO_2 content, CO_2 flux value can be estimated with some corrections. Here, we preliminarily show measured temporal changes of CO_2 content.

Before we show the measurement results, we should present that CO_2 flux may increase due to biological activity. Figure 4 shows results of temporal CO_2 increase on a plastic sheet with soil and no soil, showing that soil produces large amount of CO_2. This result indicates that we should carefully interpret CO_2 flux data when we discuss transportation of magmatic CO_2.

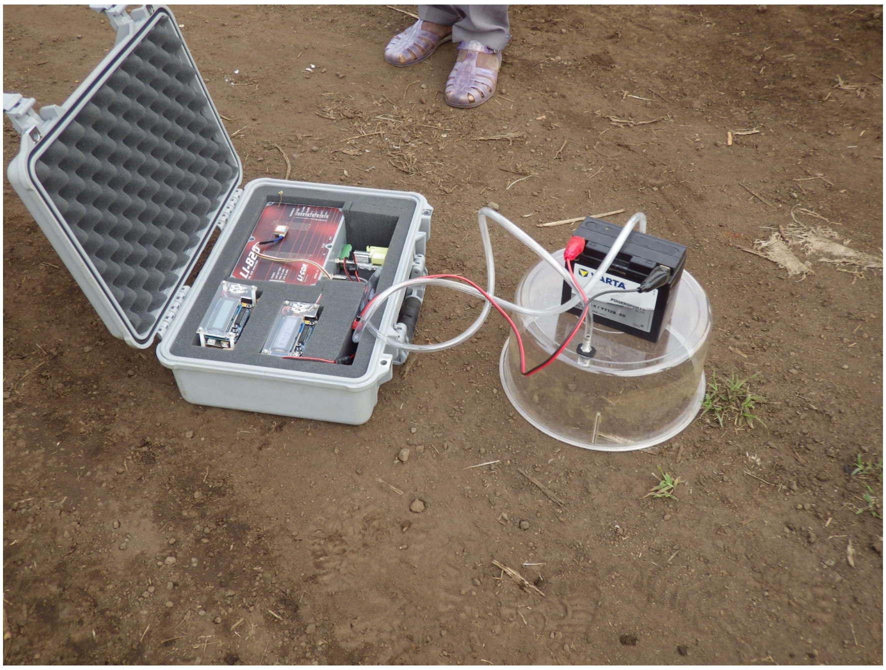

Photo 1. The device of CO_2 flux measurement.

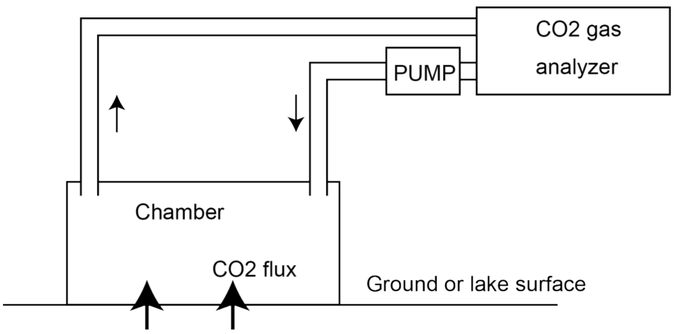

Figure 3. Schematic illustration of the device of CO_2 flux measurement.

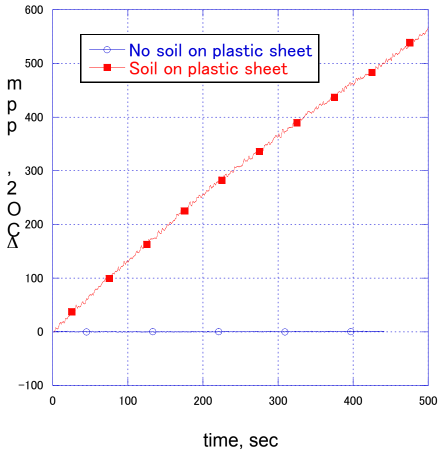

Figure 4. Results of CO_2 increase with time on a plastic sheet.

2.1. Lake Nyos

We measured diffusive CO_2 fluxes from the lake surface in Lake Nyos (Fig. 5). The results of CO_2 measurement are shown in Fig. 6.

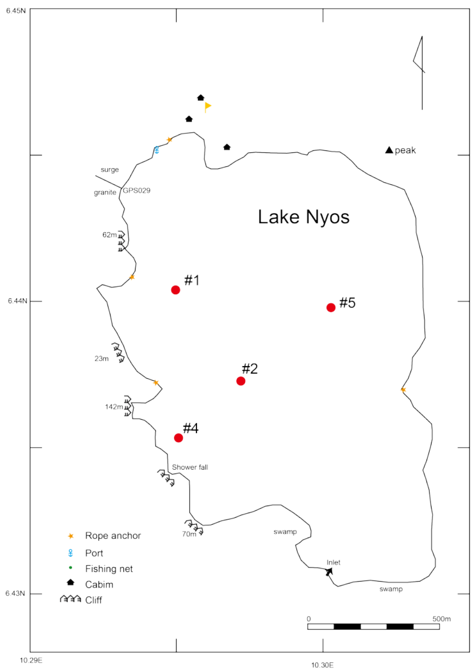

Figure 5. Locality map of measurement points of CO_2 flux in Lake Nyos.

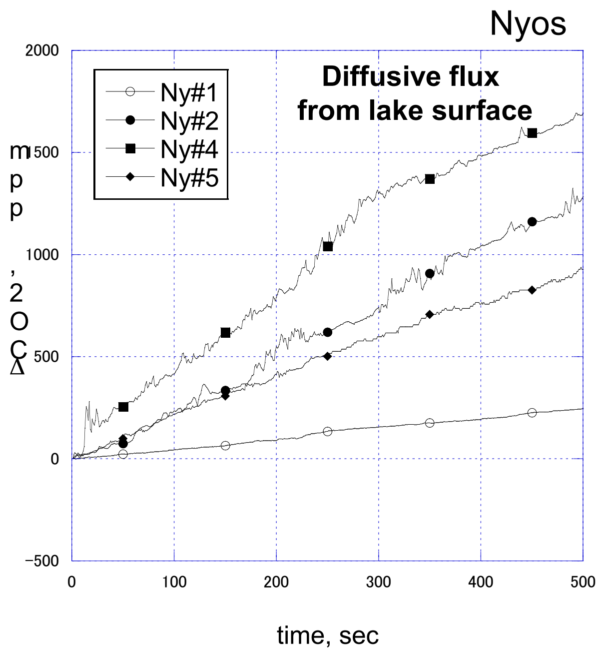

Figure 6. Results of CO_2 measurements at Lake Nyos.

2.2. Lake Monoun

We measured diffusive CO_2 fluxes from the lake and ground surfaces at Lake Monoun (Fig. 7). Results of CO_2 measurements are shown in Fig. 8. CO_2 flux from lake surface is high at Mo#3 (Fig. 8a). We observed some bubbles on the surface of the lake around Mo#3, which may suggest that there is some kind of source supplying CO_2 below Mo#3. Results of CO_2 flux from ground clearly show that CO_2 fluxes at field is much higher than those at road (Fig.8b). The soil at field is soft cultural soil with chips of plant whereas the solid at road is trodden hard without plant. The high CO_2 fluxes at the field are likely from biological activity in the soil.

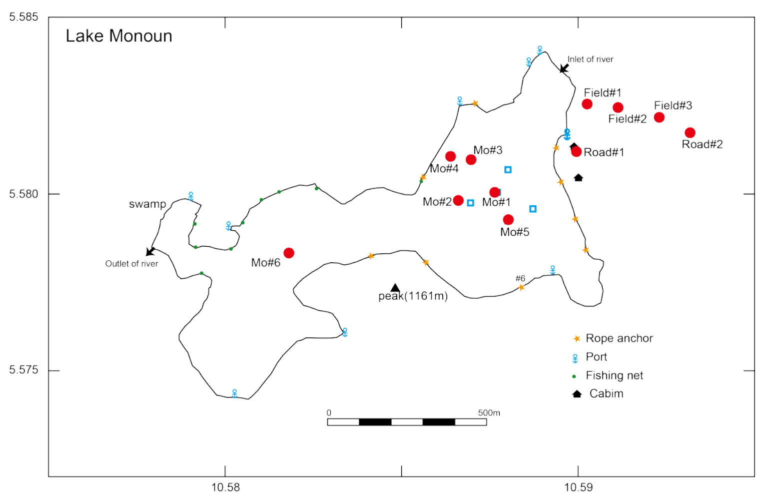

Figure 7. Locality map of measurement points of CO_2 flux at Lake Monoun.

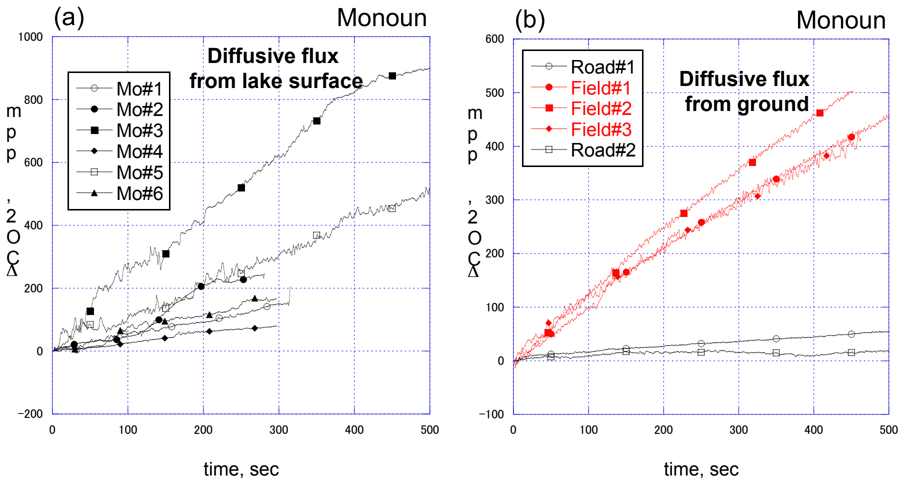

Figure 8. Results of CO_2 measurements on lake (a) and ground (b) at Lake Monoun.

3. Photography and colorimetry of the bottom of the lakes by an underwater camera with pressure container

We took movies of the under-water and the bottom of the lakes using an underwater camera with a pressure container of 200 m resist (Fig. 8). The vertical change of transparency and color of water was observed by checking the visibility of front and rear reflectors (Fig.8-10). A pressure sensor simultaneously monitored the depth. The range of cloudy water layer with suspending substance was 0-4 m at Lake Nyos.

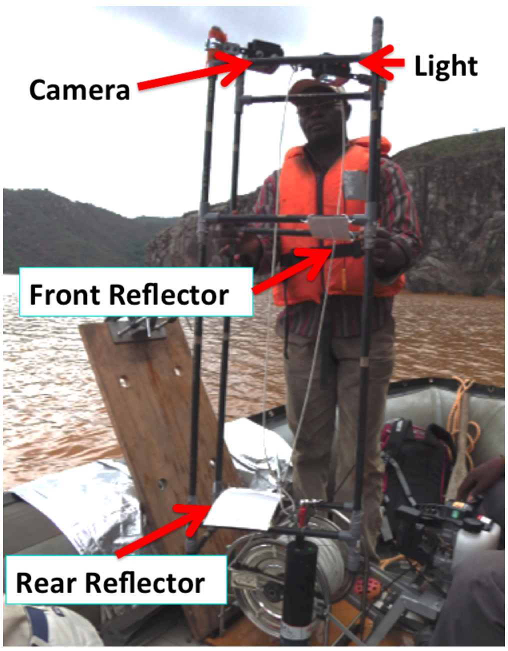

Figure 8. Position of an underwater camera and reflectors.

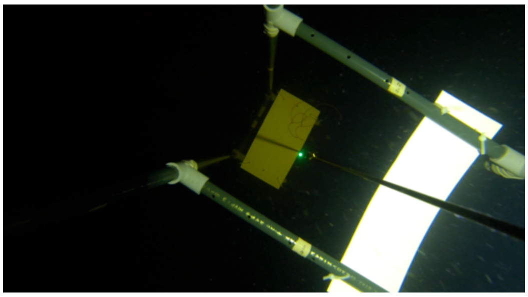

Figure 9. Underwater view at Monoun.

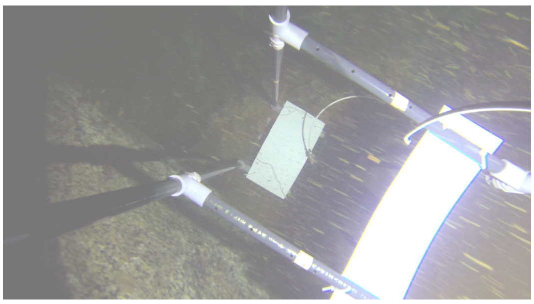

Figure 10. Lake-bottom view at Nyos.

4. Bathymetry of Lake Monoun using a GPS SONAR.

A single-beam GPS SONAR (Lowrance HDS-5 Gen2) survey of the lake Monoun was performed. The bathymetric model (Fig.11) was constructed by a computer aided bathymetry software Reef Master Pro. We are now refining the accuracy of the interpolated part of bathymetric map. New detailed topographic features have been revealed. The branch depth of sound velocity profile (Fig. 2) can be explained by the topographic features between the central and the eastern basins.

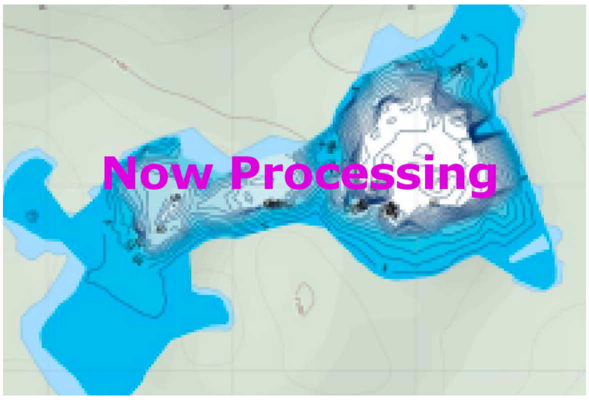

Figure 11. Bathymetric map of Lake Monoun (temporary version).