

The Nyos Organ Pipes program: Lake Monoun has been completely degassed and Lake Nyos will be safe within five years

HALBWACHS Michel

University of Savoie, France

E-mail: michel.halbwachs@wanadoo.fr

For more than twenty years, a French team of scientists carried out a many-sided project to enhance safety in the surroundings of two gas-laden crater lakes, Monoun and Nyos, in Cameroon. The project included humanitarian, scientific and technical aspects, and was completed by the end of 2011. The degassing technique was first developed during an experimental period from 1990 to 2001. It was then applied on an industrial scale, during which a controlled removal of carbon dioxide from the two lakes was performed at a much higher rate than the natural recharge. The risk of another gas burst from these lakes has thus been eliminated.

Three columns (vertical pipes) were installed in Lake Monoun between 2003 and 2006, and the complete degassing was achieved in late 2009. At Lake Nyos, the first permanent column was installed in 2001 and has worked non-stop since then. Two supplementary columns of a larger diameter were added in 2011. The height of the fountains of water and gas, originally 50 meters, is reduced by now (January 2013) to less than 6 meters.

Due to the safety requirements, the stratification of each lake has to be carefully monitored, because of its definite influence on the stability of the lake water.

In Lake Monoun, the degassing process benefited from ideal circumstances. The salts of iron (iron carbonate, or siderite) were oxidized during the surface discharge and transformed into solid particles of ferric hydroxide, which precipitated down to the depths of the lake. The balance between the loss of the dissolved gas and the precipitation of salts, at a fairly higher temperature than the bottom one, results in a low density for the rejected water, which thus stays at the surface. A steady subsidence of all the layers of the lake is confirmed on the CTD profiles. The layers don't mix, and the stability of the lake is not put at risk.

In Lake Nyos, the dangerous layer, rich in dissolved gas and located between 185 m and 210 m, was removed during the years 2001-2011, due to the functioning of the first column. In the mean time, we observed that the surface layer (0 m - 50 m), originally perfectly differentiated from the underlying layers containing dissolved gas, underwent a de-stratification at the thermocline. A mixing zone appeared between 70 m and 90 m. The impact of the de-stratification on the stability of the whole lake has to be monitored, especially because stability is greatly decreased due to the disappearance of the deeper layers, originally charged with dissolved gas.

This presentation describes some of the scientific and technical issues of the overall project and presents data pertaining to the response of certain limnological key parameters of the ongoing degassing process. The pattern of the future Lake Nyos internal structure evolution was calculated using the efficiency of the extraction of water as inferred from the evolution of the gas concentration vs. depth distribution.