On-site analysis of gas concentrations in Lake Kivu, Central Africa

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Lake Kivu is known for its uniquely huge reservoir of dissolved CO_2 and CH_4 in the stably stratified deep water (between 250 and 480 m). While the CO_2 is provided by subaquatic groundwater sources, CH_4 is believed to be mainly of biologic origin (degradation of organic matter and CO_2 reduction). The CH_4 reservoir is considered a valuable resource for electricity production. Most recently, a 25 MW power plant has been connected to the Rwandan grid.

In order to estimate the amount and production rate of CH_4 in the lake, accurate gas concentration measurements are needed. Here, we present the results of a field campaign which took place in January 2017 near Gisenyi at the northern shore of the lake.

We used a portable membrane-inlet mass spectrometer operating at gas equilibrium (GE-MIMS [1]) to derive an on-site vertical profile of gas concentrations. A submersible pump provided the continuous sample water flow required to maintain gas equilibrium at the inlet. Below 250 m depth however, gas concentrations quickly increase and thus gas pressure alone is capable of lifting the water to the surface where the water-gas mixture is separated by means of a special spray chamber. Both phases are then analyzed using the GE-MIMS (gas directly and water via a membrane). Finally, gas and water flow rates are measured to compute in-situ gas concentrations in the water column.

The method described above was used to determine CH_4, CO_2, Argon and Helium concentrations on-site in the lake. He concentrations were found to increase with depth whereas Ar concentrations remained constant. Currently, the laboratory based analysis of $^{3,4}He$, other noble gases and CH_4 are ongoing. We will discuss these results in concert with the on-line measurements to analyze the (recent) gas dynamics in Lake Kivu.

[1] Brennwald et al. (2016), *Environ. Sci. Technol.*, 50 (24), 13455–13463