Noble gas profiles from Lake Kivu: Where have the atmospheric gases gone?

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Lake Kivu, Central Africa, is well-known for the huge reservoir of dissolved carbon dioxide and methane in its stratified deep waters. While the resulting high gas pressure poses a risk for a limnic eruption, the methane is currently being used for electricity production. However, there is a general lack of knowledge about the origin, transport and fate of the gases in Lake Kivu. To shed light on these processes, we measured noble gas profiles in the lake. We used the well-established copper tube sampling technique and extended it to work in the strongly outgassing conditions prevailing in Lake Kivu's deep water. In addition, we developed and applied a novel method using a mass spectrometric system to measure carbon dioxide, methane and noble gases directly on-site.
The results show a distinct decrease with depth of atmospheric noble gases Ne and Ar. The deficit with respect to atmospheric equilibrium amounts to about 50% in the stratified deep water. We can explain this deficit by i) continuous outgassing of Lake Kivu's deep water, ii) residual concentration from past large outgassing events, iii) the inflow of noble gas depleted groundwater, or a combination of the different mechanisms.