

How dangerous is Lake Kivu – causes and risks of a possible limnological gas eruption?

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Lake Kivu is one of the large East African Rift Lakes with a surface area of 2400 km² and a maximal depth of 485 m. The deep waters of Lake Kivu contain enormous amounts of dissolved carbon dioxide (250 km³ STP) and methane (60 km³ STP). The release of only a fraction of these gases could have catastrophic consequences for the densely populated region. The gas eruptions from the two Cameroonian crater lakes Nyos (Sigvaldason, 1989) and Monoun (Sigurdsson et al., 1987) in the 1980's, which caused the death of altogether about 1800 people, showed that gases can accumulate over long time scales in the deep water of a lake and then suddenly erupt. In the case of Lake Kivu, the vertical mixing is extremely weak, allowing the gases to accumulate for almost 1000 years in the deep water below 250 m depth. Presently, the gas concentrations in the lake are below 60% saturation throughout the water column (Figure 1), and an extraordinary event would be needed to trigger a gas eruption. Because of its lower solubility, the partial pressure of methane is much higher than that of CO₂, despite its lower concentrations. A gas eruption in Lake Kivu would therefore be triggered mainly by methane, but the erupted gas mixture would nevertheless mainly contain CO₂.

Recent measurements indicate that the methane concentrations in the deep water of Lake Kivu increased by 15-20% during the last 30 years (Schmid et al., 2005). The increase in methane concentrations occurred simultaneously to changes in the vertical distribution of nutrients within the lake. As the methane is mainly of biogenic origin, it can be concluded that the increase in methane concentrations was most probably due to changes in the food-web within the lake. Possible causes for the enhanced nutrient export from the surface layers are higher nutrient inputs due to the growing human population or changed lake-internal nutrient pathways caused by the introduction of the fish species *Limnothrissa miodon*. Because of the increased gas concentrations, the heat input needed to trigger a devastating gas release by a magma intrusion into the deep water has significantly decreased. With the estimated recent methane production, the gas concentrations could approach the critical saturation levels within this century. As a consequence, a new research project has been initiated to study in more detail the cycling of nutrients and methane in the lake.

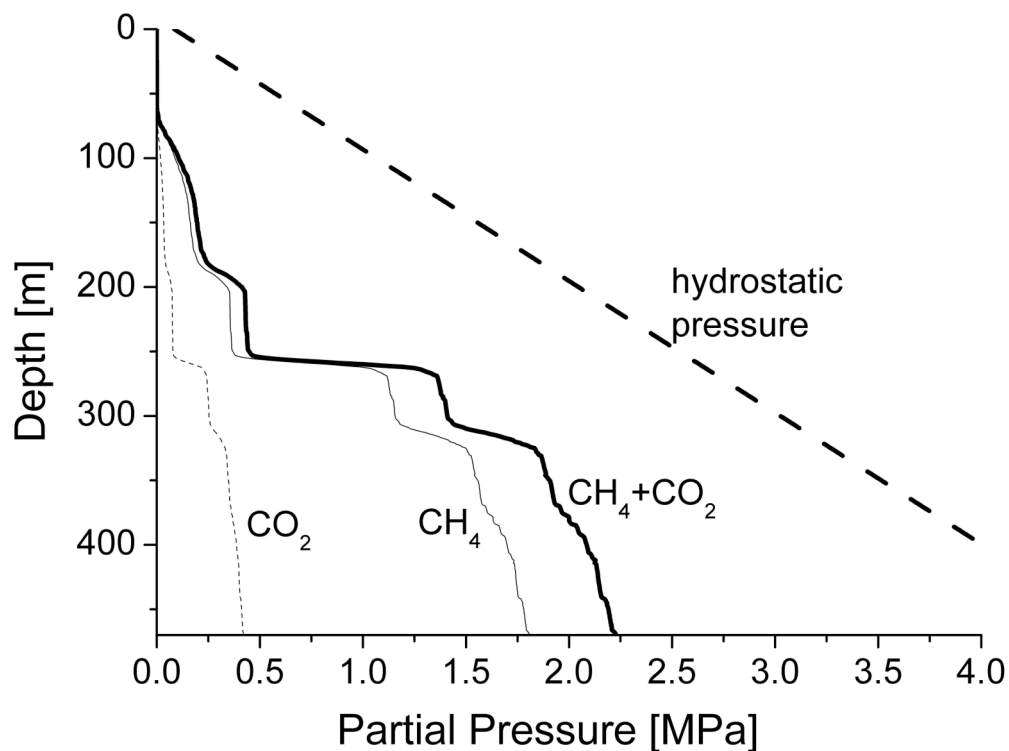


Figure 1. Partial pressures of the gasses dissolved in the water column of Lake Kivu in 2004. The hydrostatic pressure is shown for comparison.

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