Contribution to the description of nitrogen cycle in the surface waters of Lake Kivu

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Lake Kivu, located at the border between Rwanda and the Democratic Republic of Congo, is one of the great lakes of the East African Rift. With a volcanic origin, Lake Kivu is an oligotrophic lake characterized by anoxic deep waters rich in dissolved gases (methane and carbon dioxide) and nutrients, and by well oxygenated and nutrient-depleted surface waters. If the carbon cycle in the lake has been the subject of numerous studies, the nitrogen cycle remains largely unknown. In particular, pelagic sources and losses of reactive nitrogen have not yet been quantified. Thus, our work was aimed in particular to identify and quantify the processes of nitrogen losses by denitrification and/or anammox, and to quantify the biological fixation of atmospheric nitrogen. During a sampling campaign conducted in February 2012, isotopic labeling experiments were used to quantify denitrification and anammox rates along vertical profiles at two pelagic stations of the main lake and into the bay of Kabuno. No anammox process were observed. The heterotrophic denitrification took place under the oxic-anoxic interface in the bottom of the nitracline at depths between 50 and 70 m. The average denitrification rate was estimated at 115 µmoles N m^{-2} d^{-1}. Denitrification was not the only nitrate-consuming process and dissimilative nitrate reduction to ammonium might be an important process in the nitracline of Lake Kivu. Meanwhile, the rate of biological fixation of atmospheric nitrogen, estimated at one pelagic station, was estimated to 832 µmoles N m^{-2} d^{-1}. Isotopic labeling accompanied by addition of sulfides in the main lake and iron in the bay of Kabuno allowed, for the first time in a tropical great lake, to highlight important linkages between nitrogen and sulfur cycles, and, by an unique way, between nitrogen and iron cycles. On the other side, the anaerobic methane oxidation by nitrate was not observed and results rather suggest the presence of methane oxidation by sulfate. Finally, inhibition of the activity of sulfate-reducing bacteria has allowed to observe potential anaerobic nitrification in the main lake.