Strong CO_2 and CH_4 efflux from Dziani Dzaha crater lake: Implications on carbon budget.

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Dziani Dzaha is a tropical crater lake located on Mayotte island (Indian Ocean, France). Waters are saline, alkaline (pH 9-9.5 and alkalinity ~0.23 M), permanently anoxic below ~1.5 m depth, and sulfidic in the deep layer during the stratified period (*i.e.* the rainy season). The trophic network is very simplified: microalgae, prokaryotes and viruses. The huge biomass is mainly represented by a one cyanobacteria (*Arthrospira* sp.) and one microalgae (*Picocystis salinarum*) for the producers, bacteria and archaea for mineralizers [1].

We determined the fluxes of CO_2 and CH_4 at the air-water interface during five field campaigns (2014-2016) by the floating chamber method coupled to gas sensors. In spite of high pH and strong photosynthesis during daytime (up to 300% dissolved oxygen saturation), CO_2 was systematically emitted towards atmosphere (from 40-60 to 200-220 mmol/m^2/d during the wet or dry season respectively).

Methane fluxes were very high, reaching ~40 mmol/m^2/d during the dry season (unstratified water column) and 100-140 mmol/m^2/d during the wet season (stratified water column by halocline). The ebullitive part of the flux accounted up to 20% of the total CH_4 emission. Such high total efflux, especially in the stratified situation, may be due to the low thickness (< 2 m) of the upper layer, overlaying CH_4-rich waters (up to 2 mM). Moreover, during the stratified period, some evidences support an active methanogenesis in the water column below the halocline.

These strong emissions of both CO_2 and CH_4 have to be taken into account in the carbon budget and related to the isotopic composition of C in this lacustrine system. Indeed the elevated $\delta^{13}C$ of DIC (+13‰) may be explained by the escape of light C through the CH_4 efflux ($\delta^{13}C_{CH4}$ ~ -65‰). This peculiar lake may help to better understand some sediment records from the past, *e.g.* the large positive $\delta^{13}C$ excursion encountered during the Paleoproterozoic.

[1] Leboulanger *et al.* 2017, PLoS ONE 12(1) pp.e0168879