

Input rate of sublacustrine gas into Lake Nyos (Cameroon, West-Africa) inferred from diffuse CO₂-flux measurement and hydrological observations

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Because of its importance to understand the mechanism and the origin of the mid 1980s fatale exhalation of gas, mainly magmatic carbon dioxide (CO₂) from Lake Nyos, on one hand, and on the other hand, for the sake of preventing and management of future gas explosion related hazards in Nyos area, the hydrothermal system of the lake was extensively investigated over the last quarter the century with the objective to quantify CO₂ recharge rates and determine the feeding paths. More than 25 years after the catastrophe which killed 1734 people in the North-West Region of Cameroon, we revisit the question which remains of primary importance with regards with the extraordinarily high rate of gas build-up observed soon after the gas disaster. Based on results of diffuse CO₂ measurement (CO₂-flux) surveys we conducted in January 2009 and information on the hydrological system, input rate from hydrothermal system was estimated at 258.4 (0.7) Mmol/yr. The value estimated above using a mass balance equation $CO_2^{input} = CO_2^{acc} + CO_2^{flux}$, (where CO_2^{input} , CO_2^{acc} and CO_2^{flux} stand for inputs from hydrothermal system, accumulation rates and diffuse CO₂ loss respectively) implies about 42.6 (0.3%) of gas supplied from beneath the lake accumulates to constitute the time bomb. If we compare the gas rate and the ground water input rate at depth below 50 m of 9 l/sec estimated from hydrological observations, the ensuing gas-

rich water would attain a concentration of 0.9 mol/l implying 136% saturation (e.g saturation level of 0.630 mol/l maximum) at system pressure (210 m depth). We believe that the high gas-rich water supply type model which was more or less accepted for past several years is incompatible with observations above because of the plumes gas oversaturated waters may generate. Instead, we advocate for a diffusional type model in which gas is supplied in the form of pure CO₂ distributed throughout sediment/water interface where the specific flux would be 23 micromol/sec/m². The view complements well the absence of horizontal anomalies (gas is evenly distributed) as suggested by several transect profiles of the lake. Else, this study permits distinguish between the recharge rate (=accumulation rate) which relates to time required for the event to repeat itself and the input rate related to activity of sublacustrine system.

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