Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19777

Non conservative behavior of chlorine in tropical hydro-systems: evidence from thermonuclear ^{36}Cl in Cameroon lakes.

SOULEYMAN ABBA, BRUNO HAMELIN, YANNICK GARCIN AND PIERRE DESCHAMPS

CEREGE, Aix Marseille Univ, CNRS, IRD, INRAE, Coll France

Presenting Author: souleyabba2@gmail.com

^{36}Cl is an isotopic tracer which can been used to constrain groundwater ages, to depict groundwater dynamics, and to estimate recharge and water transit time in catchments or lakes, due to (*i*) its long half-life (301000 years) and (*ii*) the large amounts released during the marine thermonuclear tests in the 1950's, based on the assumption of a conservative behavior of chloride.

In the present study, we present an isotopic approach to determine the water residence time, using ^{36}Cl measurements in five volcanic lakes (Mbalang, Tabere, Tizon, Gegouba and Baledjam) of the Adamawa plateau in the northern region of the Cameroon Volcanic Line.

The chloride content of these lakes is low (average values ranging from 9 to 35 μeq/L) but is higher than that of the rainwater samples (1.9-9.5, 3±0.1 μeq/L on average). The $^{36}Cl/Cl$ ratio measured in the lake samples ($1000*10^{-15}$ to $3000*10^{-15}$ at/at, also different from one lake to the next) is higher by at least one order of magnitude than the natural atmospheric ratio ($200*10^{-15}$ at/at) as determined previously from groundwater measurements in the lake Chad basin (Bouchez et al., Scientific Report, 2019). This gives a clear signature of the nuclear imprint.

Using the lakes ^{36}Cl composition that we measured and the historical reconstitution of ^{36}Cl deposition of the Adamawa region from the previous study of Hekkilä et al. (Atmospheric Chemistry and Physics, 2009), we can simulate the $^{36}Cl/Cl$ ratio time variation in the lakes. The results of this simulation depend on two parameters: the water residence time and the (E/I) ratio between evaporation and water input. Knowing the time-function of the input ratio and the E/I ratio inferred from the chloride budget, the water residence time is assessed by fitting the observed $^{36}Cl/Cl$ ratio. However, this method gives lower water residence time values (between 1.5 and 6.5 years) than those obtained from the classical approach using water fluxes through the lakes (between 4.5 and 21 years). This forces us to reconsider the basic postulate when using chloride in water balance, namely the conservative behavior, as well as the simulations of thermonuclear ^{36}Cl fallout during the last decades.