Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19115

Radium isotope study in Lake Kivu: implications to the travel time of sub-lacustrine hydrothermal discharge

YISHAI WEINSTEIN[1], RONEN ALKALAY[1], ANGE MUGISHA[2] AND ERIC MUDAKIKWA[2]

[1]Bar-Ilan University
[2]REMA

Presenting Author: weinsty@biu.ac.il

The research of potentially 'killer lakes', which are meromictic lakes that accumulate large inventories of harmful gases in their deep water, is of very high importance due to their possible severe impact on human life and well-being. This was unfortunately demonstrated in the limnic eruptions of Lake Monum and Lake Nyos in 1984 and 1986, respectively. Lake Kivu is a deep (485m) meromictic lake, located along the western branch of the East African Rift, at the foot of the highly active Nyiragongo volcano. Lake stratification is maintained via discharge of hot and saline springs at depth and cold and fresh springs (as well as surface flow) at shallow layers, enhanced by recent warming of surface water. The deep lake holds very large volumes of both CO_2 and CH_4 (300,000 and 60,000 km^3, respectively), mainly of geogenic origin. In a field campaign during Sept. 2022, we sampled a water column profile, as well as onshore fresh and hydrothermal springs for Ra isotopes. Although ^{226}Ra increases with depth, its deep water (400m) activities are fairly low (2,000dpm m^{-3}). On the other hand, ^{228}Ra is quite high (100dpm m^{-3}), considering its much shorter half-life (5.75 years, compared with 1600 years of ^{226}Ra). While the relatively high ^{228}Ra could possibly be attributed to diffusion from sediments or desorption from sinking or re-suspended matter, the low ^{226}Ra should reflect either on recent lake overturn or on low activities in the sub-lacustrine discharge. Taking into account that no lake overturn took place during the last several 100's years, isotope budgets suggest that ^{226}Ra activities in the sub-lacustrine discharging groundwater are quite low (2,500dpm m^{-3}), compared with onshore hydrothermal springs (15,500dpm m^{-3}), as well as other hydrothermal systems. Assuming that onshore springs represent (minimum) secular equilibrium ^{226}Ra activities for the aquifer hydrothermal system, the low activities in discharging water suggest that the aquifer travel times of the sub-lacustrine hydrothermal groundwater are no more than a few years (velocities of several km/yr). This further highlights the need for actual sampling of the sub-lacustrine discharge, which will possibly also allow constraining the time of last lake overturn.