Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17070

Young apparent ages (<1000 years) of hyperalkaline groundwater in the peridotite section of the Samail Ophiolite, Oman

AMELIA N PAUKERT VANKEUREN[1], MARTIN STUTE[2], JUERG MATTER[3], FLORIAN MEIENBURG[4], WERNER AESCHBACH[4], MARKUS OBERTHALER[4] AND GRACE BROWN[5]

[1]California State University, Sacramento
[2]Lamont-Doherty Earth Observatory
[3]University of Southampton
[4]Heidelberg University
[5]Barnard College - Columbia University

Presenting Author: vankeuren@csus.edu

The rate of peridotite (mantle rock) alteration (serpentinization, oxidation, and carbonation) by meteoric water in a continental environment remains unknown. Lab experiments suggest low-temperature alteration should be minimal, but field evidence in the form of hyperalkaline (pH >11) water with H_2 gas in ophiolites around the world suggests it may occur at a significant rate. Groundwater ages in peridotite provide a possible constraint on alteration rates by serving as a maximum timeframe for this water-rock interaction.

Groundwater in the mantle section of the Samail Ophiolite, Oman has been evaluated using multiple age tracers: ^{3}H, ^{39}Ar, and ^{14}C. Type I shallow Mg-HCO_3 groundwater samples have ^{39}Ar apparent ages ranging from modern to 210 years, while uncorrected ^{14}C ages range from 240 to 14,000 years. d^{13}C in these samples is -15 to -9 ‰ and ^{3}H is 1 to 2 TU, though one sample has 0.4 TU. This water may be considered the starting point for continued alteration in a system closed off from the atmosphere. The resulting Type II hyperalkaline (pH >10) Ca-OH waters have ^{39}Ar apparent ages ranging from 90 to 720 years and uncorrected ^{14}C ages from 820 to 12,000 years. These samples are depleted in d^{13}C with values of -22 to -17 ‰. ^{3}H is less than 0.7 TU. Tracer distributions suggest that two or more component mixing is likely an important process in this fracture flow dominated system.

The apparent disparity between ^{39}Ar and uncorrected ^{14}C ages may be attributed to changes in ^{14}C along the groundwater flow path. NETPATH simulations demonstrate that precipitation of carbonate minerals and associated fractionation can account for the removal of dissolved carbon and depletion of d^{13}C along the path from Type I to Type II groundwater, but that exchange with old carbonate veins within the ophiolite is necessary to attain ^{14}C ages so much older than the ^{39}Ar ages.

The relatively young (<1000 years) ^{39}Ar ages of Type II groundwater samples suggest that the geochemical processes responsible for producing hyperalkaline Ca-OH water are either faster than previously thought, or mixing and/or other chemical reactions are at play.