Characterizing flow and hydrogeochemistry of groundwater using a multi-isotope approach in basaltic aquifers affected by magmatic CO_2 (Jeju Island, Republic of Korea)

DONG-CHAN KOH[1,2*], DAVID P. GENEREUX[3], GI-WON KOH[4], KYUNG-SEOK KO[1,2]

[1] Korea Institute of Geoscience and Mineral Resources, Daejeon 34132, Republic of Korea
[2] University of Science and Technology, Daejeon, 34113, Republic of Korea
[3] Marine Earth and Atmospheric Sciences, North Carolina State University, Raleigh, North Carolina, USA
[4]Jeju Province Development Corporation, Jeju-si, Jeju Special Self-Governing Province, 63345, Republic of Korea

Groundwater in volcanic aquifers can be controlled by highly heterogeneous permeability structures in terms of flow and hydrogeochemical characteristics. In addition, CO_2 from various sources can affect groundwater mineralization. Groundwater from pristine volcanic aquifers of Jeju Island, Korea, was investigated to identify sources and geochemical processes of dissolved inorganic carbon (DIC) and related solutes along with characteristics of groundwater flow using a multi-isotope approach including δ^{13}C-DIC, $^{87}Sr/^{86}Sr$, $\delta^{18}O$, δD, and ^{3}H. From a previous study [1], groundwater in the area was classified as low-mineral water, Mg-rich mineral water, Na-rich mineral water, and CO_2-rich water. Tritium levels showed groundwater is composed of recent recharge except for Na-rich mineral water. Sr isotopic ratios of groundwater is similar to those of the lower part of the lava flows. δ^{13}C indicates that DIC in low-mineral water derived from soil CO_2 while DIC in mineral water and CO_2-rich water was considerably contributed by magmatic CO_2 with signatures of upper mantle. Based on δ^{13}C and ^{3}H, groundwater was classified as four types. Each type of groundwater was discussed in terms of their spatial distribution, CO_2 sources, mineralization, and relations to the volcanic history of the island.

[1] Koh, D.-C., Chae, G.-T., Ryu, J.-S., Lee, S.-G., Ko, K.-S., 2016. Appl. Geochem. 65, 87-102.