U-Th-Ra-Rn-He relationships in Mojave River Basin groundwaters

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U-Th series nuclides have been measured in groundwaters from the semi-arid Mojave River Basin (MRB) California in order to better understand production, release, distribution and transport of ^{4}He progenitors within the aquifer. All groundwaters have been analyzed previously for ^{4}He and ^{14}C (Kulongoski et al, 2003).

^{234}U/^{238}U activity ratios of the youngest waters are <1, suggesting that the U is derived from weathering of ^{234}U depleted unsaturated soils in the semiarid catchment. Higher ratios further within the aquifer (1.1-1.3) do not vary over long timescales, indicating a constant ratio of recoil to weathering. Thus, active weathering occurs throughout the aquifer. An exceptional value of <1 in the oldest water suggests a deep, previously ^{234}U depleted source. The ^{222}Rn recoil fractions (~0.02) and activities (3-6x10^{4} dpm/100L) are much higher than anticipated by α-recoil from coarse-to-fine grain sands, and therefore may be a result of U-Th-Ra rich surface coatings or preferential escape routes within the grains (microporosity). Also, the activity ratios of ^{226}Ra/^{228}Ra (0.3-0.5) and ^{224}Ra/^{228}Ra (0.3-3.7) suggest varying rates of fractionation/adsorption of Th-Ra progenitors along the aquifer path.

In most samples, ^{4}He concentrations exceed that expected by supply of total He production within the aquifer rock, particularly in the oldest waters. Both He and Rn are produced in situ; however, unlike Rn, there will be additional contributions of He from either stored He in the aquifer rock and/or from an extraneous (deep crustal or mantle) source.

Reference

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Experiment study on validity of LCL and critical Re for groundwater flow in a single fracture

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Groundwater flow has an important role on affecting chemical and biological processes within both the water column and the sediments. The groundwater movement in naturally fractured media is highly complex due to the strongly varying velocity fields. A critical issue in the discrete model is the validity of the Darcian-type "local cubic law" (hereinafter denoted LCL). To test the validity of LCL, according to the simulated tests in laboratory, the average velocity with a lower gradient (0.0005-0.0015) in a single fracture is calculated by the LCL. And it is compared with the measured average velocity. Reynolds number (Re) of groundwater is calculated, and the critical value of Re for laminar flow is studied in a single fracture under different conditions. The conclusions have been drawn: (a) under the condition of hydraulic gradient 0.0005-0.0015, the LCL is invalidity to calculate the average velocity in a single fracture; (b) the flow in a single fracture should be non-Darcy's flow; and (c) the Reynolds number of flow in a single fracture is between 4.980 and 32.376; the critical values of Reynolds number, Re, in a single fracture should be less than the value 4.980.

Acknowledgments

This study is financially supported the National Natural Science Foundation of China (Nos. 40202027 and 40472130) and and Fok Ying Tung Education Foundation (No. 91079).

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