Goldschmidt 2024 Abstract
https://doi.org/10.46427/gold2024.23572

Uranium-series isotopes in the critical zone: new developments of a watershed tracer for climate, lithology, and land use

LIN MA[1], NURIA ANDREU[1], LOURDES MOREU[1], GRACE GOLDRICH-MIDDAUGH[2], JENNIFER HERERRA[1], JASON RICKETTS[1] AND PAMELA L SULLIVAN[2]

[1]University of Texas at El Paso

[2]Oregon State University

Presenting Author: lma@utep.edu

Dissolved (^{234}U/^{238}U) ratios in rivers have great potentials to improve understandings of watershed and critical zone processes such as flow paths, residence times, bedrock weathering, and surface-groundwater interactions. However, their wide applications to solve many critical zone problems have been hindered by the inability to decipher the multitude of mechanisms that control dissolved (^{234}U/^{238}U) ratios across climate, lithology, and land use gradients. Here, we leverage the strong environmental and geologic gradients across two Texas river basins (Colorado and Pecos) at the important regional scale with sizes ranging from 10s-100s of km^2. We used a combined geochemical, geological, and geographic information system (GIS) approach to study the controls on the dissolved (^{234}U/^{238}U) ratios in Colorado and Pecos rivers. We investigated 22 river sample sites under different impacts of precipitation, lithology, and land uses for both rivers. Seasonal variations of river chemistry and (^{234}U/^{238}U) ratios were observed along the Colorado and Pecos river due to the different climate and human impact parameters. U isotope ratios and concentrations were simulated with existing U isotope fractionation models across this matrix of drivers and both U parameters reflect closely water residence time from water-rock interactions in the watersheds. Our project aims at testing the umbrella hypothesis that riverine (^{234}U/^{238}U) ratios can be predicted by quantifying factors of alpha recoil and chemical dissolution at the weathering interfaces with 1) climate parameters of the watershed; 2) lithological parameters of the weathering bedrock; and 3) water residence times; while 4) land uses (such as agriculture and urban development) can overprint these natural signatures. The new developments highlight that the dissolved (^{234}U/^{238}U) ratios are a great tracer for climate, lithology, and land use in watersheds.