

Parsing routes to aquifer recharge along mountain fronts

February 11 2021, by Terri Cook



Tucson, Ariz., seen here with the Santa Catalina Mountains in the background, is one of many large urban areas dependent upon groundwater, a limited resource that must be carefully managed to ensure adequate supplies as the climate changes. Credit: John Diebolt/[Wikimedia](#), [CC 1.0](#)

In many semiarid and arid regions around the world, groundwater drawn from basin-fill aquifers sustains local agriculture and large cities. Such aquifers are typically replenished by high-elevation precipitation and snowmelt along encircling mountain fronts via several pathways. These pathways include infiltration from streams, diffuse subsurface flow from the mountains to the basin, and focused subsurface flow along features like faults. Distinguishing among these various means of mountain front recharge is necessary to effectively manage aquifers' limited water supplies, but it can be challenging because the waters moving through different paths can be difficult to sample and often have similar chemical fingerprints.

Now Markovich et al. show that a combination of techniques can be used to address these challenges. Because the various components of mountain front recharge can differ substantially in terms of flow velocity, the distance the water travels, and the elevation at which recharge occurs, the team hypothesized that groundwater age dating, combined with thermometric methods and numerical modeling, could be used to distinguish between them. To test this approach, the team applied a suite of techniques, including [noble gas](#) and [isotopic tracers](#) such as radiocarbon, krypton-85, argon-39, and tritium, to characterize the groundwater pumped from six wells in Arizona's northern Tucson Basin.

The tracers indicated the presence of very old water in one well located in weathered bedrock near the mountain front, as well as modern water mixed with a small percentage of older water in two basin production wells. Collectively, the authors say, the results indicate that this multifaceted approach can be used to characterize the sources of groundwater and dominant flow behavior in basin-fill aquifers and that this information can, in turn, be used to quantify both the subsurface and the surface components of mountain front recharge. Because [climate change](#) may affect the amount and timing of each recharge component in different ways, this approach represents an important step forward in

obtaining the data needed to sustainably manage these crucial [water](#) sources in the present and future climates.

More information: Katherine H. Markovich et al. A Mountain-Front Recharge Component Characterization Approach Combining Groundwater Age Distributions, Noble Gas Thermometry, and Fluid and Energy Transport Modeling, *Water Resources Research* (2020). [DOI: 10.1029/2020WR027743](#)

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