Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.34789

Stable water isotopes, tritium and major ion geochemistry constrain recharge processes and groundwater residence time in an andesitic volcanic aquifer (Pandaan, Indonesia).

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While the hydrogeological structure of andesitic volcanic aquifers is relatively well established, their functioning – particularly recharge mechanisms and groundwater circulation – remains poorly constrained [1]. Environmental tracers provide key insights into these processes. We applied a multi-tracer approach combining hydrochemistry, stable water isotopes (δ^2H-δ^{18}O) and tritium (^{3}H) in the Kedunglarangan watershed (Pandaan, Indonesia). This approach and the groundwater age modelling were constrained by prior knowledge derived from the local geological and hydrodynamic conceptual hydrogeological model. It allowed us to (i) refine the local isotopic altitudinal gradient using a bilinear model accounting for secondary evaporation, (ii) reconstruct a continuous regional ^{3}H input function for equatorial Asia (1900–present), (iii) identify seven groundwater groups and quantify residence times across volcanic units, and (iv) refine the hydrogeological functioning of recent andesitic aquifers. This research greatly improves the understanding of recharge dynamics and groundwater flow circulation of volcanic andesitic aquifers. Beyond the local case, the methodology provides tools that can be used for groundwater budget assessment and groundwater quality protection in similar volcanic contexts worldwide (*e.g.* Pacific Ring of Fire, Caribbean, Mediterranean volcanoes etc.).

References:

1. Baud, B., et al., *Review: Andesitic aquifers—hydrogeological conceptual models and insights relevant to applied hydrogeology.* Hydrogeology Journal, 2024. **32**(5): p. 1259-1286.