Geophysical Research Abstracts
Vol. 16, EGU2014-5133-1, 2014
EGU General Assembly 2014

Where is the water going: An irrigation experiment using a natural isotopic tracer in karst SE, Australia.

Monika Markowska (1,2,3), Andy Baker (2,3), Martin S. Andersen (2,3), Mark Cuthbert (2,3), Gabriel Rau (2,3), Cath Jex (2,3), Helen Rutlidge (2,3), Chris Marjo (2,3), Hamid Roshan (2,3), and Pauline Treble (1)

(1) Australian Nuclear Science and Technology Organisation, Sydney, Australia (monikam@ansto.gov.au), (2) Connected Waters Initiative Research Centre, University of New South Wales, Sydney, Australia, (3) affiliated to National Centre for Groundwater Research and Training, Adelaide, Australia

The karst unsaturated zone is a fractured rock environment associated with very heterogeneous water movement; spatial variability in the subsurface water storage; and fast preferential flow through fractures and fissures. These factors dominate the way in which water moves within the unsaturated zone in these environments, giving rise to flow path complexities less common in homogenous media. Currently there is limited research regarding karst infiltration/storage processes and potential evaporation in the unsaturated zone. Such processes may have the potential to alter the stable isotopic composition of groundwater. Caves provide a unique environment within which to examine exfiltration variability and flow dynamics in situ. In semi-arid environments evaporative processes in the unsaturated zone have been shown to directly alter the isotopic δ18O composition of cave drip waters, fractionating them towards heavier ratios, by a magnitude of 1-3 per mil relative to mean annual rainfall (Bar Matthews et al., 1996; Cuthbert et al., 2014).

Here we present a novel isotopic drip water study from an artificial infiltration experiment at Wellington Caves, SE Australia. A series of four artificial infiltration events were initiated directly over Cathedral Cave, Wellington over as many days. The first event was spiked with a deuterium tracer and the subsurface response was monitored during several sampling campaigns over the following year. The infiltration study revealed: (1) isotopic break-through curves suggest a front of older water from the unsaturated zone storage arrived ahead of the infiltration water, (2) water residence times in the unsaturated zone were found to be longer than 6 months and, (3) large spatial heterogeneities existed in the proportion of exfiltrated deuterium tracer at different drip sites in the cave suggesting unique pathways and sources of water in the unsaturated zone. Implications from this study include the interpretation of paleo-climate speleothem records from semi-arid to arid environments.

Bar-Matthews et al., (1996), Geochimica et Cosmochimica Acta, Volume 60, Issue 2, p. 337-347.
Cuthbert et al., (2014), Earth and Science Planetary Letters [manuscript submitted for publication].