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Robust transport simulations for sustainable management of groundwater in fractured rocks, need accurate observation data about fracture and matrix processes. In aquifers with naturally hot groundwaters (i.e., 30 °C in South India), heat injections can become difficult and cumbersome, considering strong density influences. Injecting cold water is a much more promising and innovative tracer technique. Injecting cold water reduces the energy stored in the matrix, as heat is released to the colder circulating fluid in the fractures. Thus, cold water injections can produce very informative reference data for managing hot fractured aquifers using groundwater flow and cold plume transport numerical modeling.

Heat and cold water tracer tests have been performed for the first time in Choutuppal nearby Hyderabad in South India. Sub-horizontal fractures have been intersected by 30 wells drilled in a weathered granite aquifer. A saprolite layer of in average 14 m thickness covers the fractured granite system. The natural granite aquifer background temperature varies yearly between 30 °C and 35 °C. During the experiments, the natural aquifer background temperature was around 30.3 °C. The most explored well (CH03) is used as injection well for all experiments. There, an inflatable double packer system isolates one sub-horizontal fracture connecting CH3 with a pumping well (CH12) located at a 5.5 m distance. This set-up allows successive 1-hour injections of 1000 L of hot water (ΔT = +20 °C) and cold water (ΔT = -20 °C).

The peak arrival times measured in CH12 are 41 minutes for heat and 51 minutes for cold water. The peak temperature difference measured in CH12 for heat is ΔT = +3.3 °C and for cold water ΔT = -2.9 °C. This is consistent with the fact that density and viscosity decrease with higher temperatures. Remarkably, cold water shows a slightly faster first arrival. It might indicate that storing energy is slightly faster initiated than releasing energy from the matrix.
First interpretations of the observed tailings show that for hot water injection, the subsequent temperature decrease (back to the background T) seems slower than the observed temperature increase after the cold water injection. It seems that cooling the matrix (i.e. reducing the energy level) is slightly more time consuming and difficult than heating the matrix (i.e. storing energy).

More experiments, e.g. repetitions of these experiments focusing stronger on the tailing for imaging matrix processes, complementing cold water tracing experiments (e.g. push-pull) and the possible parallel use of geophysical imaging tools, are ongoing. Nevertheless, the first tracer tests with cold water injections generated reference data that are very informative for further transport modeling (e.g. using Monte Carlo simulations).