AUSTRALASIAN GROUNDWATER CONFERENCE 2019

Conjoint use of hydraulic head and groundwater age data to detect hydrogeologic barriers

Sarah K. Marshall; Peter G. Cook; Leonard F. Konikow; Craig T. Simmons; Shawan Dogramaci

Hydraulic head and groundwater age data are effective in building groundwater system understanding. Yet their role in detecting and characterising near-vertical low-permeability geological structures—hydrogeologic barriers, such as faults and dykes—has not been widely studied. Here, numerical flow and transport models, using MODFLOW-NWT and MT3D-USGS, were developed with different hydrogeologic barrier configurations. Computed hydraulic head and groundwater age distributions were compared to those without a barrier. The joint use of these datasets helps in detecting vertically-oriented hydrogeologic barriers for a range of hydrogeologic conditions. Two forms of recharge were compared: (1) applied across the whole aquifer (uniform); or (2) applied only to its upstream part (upgradient).

The hydraulic head distribution is significantly impacted by a barrier (with gaps) that penetrates the aquifer's full vertical thickness. This barrier type also perturbs the groundwater age distribution when upgradient recharge prevails. However, with uniform recharge, groundwater age is not successful in indicating the barrier's presence. When a barrier is buried, such as by younger sediment, hydraulic head data does not clearly identify the presence of a barrier. Groundwater age data could, on the other hand, prove to be useful if sampled at depth-specific intervals. These results are significant for the detection and characterisation of hydrogeologic barriers where they may play a significant role in the compartmentalisation of groundwater flow, spring dynamics, and drawdown and recovery associated with groundwater extraction.