Combined use of numerical simulation and natural tracer approach to estimate groundwater flow system in a typical arid inland river basin, northwest China

*Jingli Shao[1]

1. China University of Geosciences-Beijing

Groundwater plays a crucial role in arid and semi-arid areas of the world. To obtain a better understanding and quantification of groundwater flow in arid and semi-arid inland river basins, a variably saturated numerical model of a typical arid watershed profile in Qaidam basin was constructed using the code TOUGH2 (Transport of Unsaturated Groundwater and Heat 2). Considering the dramatic change of saturated/unsaturated state near surface in the alluvial-lacustrine plain (midstream and downstream river basin), the mesh near surface is refined compared to the previous studies, and the minimum cell size is 0.1 m in thickness. Natural isotopes (such as radiocarbon and tritium) as well as hydraulic heads were used to calibrate the numerical model. The reliability of the calibrated model was further validated by comparing the results of the numerical simulation and an independent isotopes method. The results indicate that the calibrated model can efficiently reflect the characteristics of groundwater flow system at basin scale. While the natural tracer approaches are more reliable at point scale. According to the travel paths of groundwater simulated by the calibrated model, three groundwater flow systems are distinguished: the local, intermediate and regional groundwater flow system. The circulation depth, groundwater residence time as well as water circulation amount of each groundwater flow system were also calculated with the numerical model. This study demonstrates that combined use of natural tracers and hydraulic data in the numerical model calibration can construct a more reliable model and achieve better understanding and qualification of basin-scale groundwater flow.

Keywords: Numerical simulation, Tracer approach, Variably saturated, Groundwater flow, Arid area, Qaidam basin

