Characterizing nested flow systems in a large watershed using geophysical, hydrochemical and flow modelling approaches

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ABSTRACT
Characterization of nested flow systems is difficult due to the limited availability of field data and the influence of aquifer heterogeneity on groundwater flow and solute transport. Geophysical, hydrochemical and flow modelling approaches were developed and successfully applied in the Dosit River watershed inside the Ordos Plateau, which is mainly composed of relatively homogeneous sandstone aquifers.
Due to the homogeneous Cretaceous aquifer with uniform porosity, the variation in bulk resistivity of the aquifer is mainly caused by groundwater salinity. The magnetotelluric technique is used to obtain the apparent resistivity of a profile across the Dosit River. The basin-bottom hydraulic trap below the river has been detected, and its size has been found to be large enough for possible deposition of large ore bodies. The boundaries between local and regional flows have also been identified, which would be useful for groundwater exploration and calibration of large-scale groundwater models.
In the Dosit River watershed, there are numerous domestic wells with different depths ranging from several meters to almost one thousand meters, which provides a great opportunity to collect water samples with depth-dependent hydrochemistry. Cluster analysis of pH and major ions leads to five clusters with drastically different hydrochemistry [Wang et al., 2015], which could be related to the development of nested flow systems.
We also built a 3D numerical model of groundwater flow in the Dosit River watershed. Due to the complicated structure of nested flow systems in the 3D domain, it is difficult to directly partition the different flow systems based on the numerical model. The existence of one distinct late-time peak shown on the RTD indicates that the Dosit River Watershed has a two-order nested flow structure with local and regional flow systems. The results based on RTD are found to be basically consistent with hydrochemical results.

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