Spatial distributions of groundwater arsenic and uranium in the Hetao basin, Inner Mongolia, China

HUAMING GUO, YONGFENG JIA AND WEIGANG ZHAO[12]

[1]State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences, Beijing 100083, PR China

[2]School of Water Resources and Environment, China University of Geosciences, Beijing 100083, China

High As groundwater has been found in the shallow groundwaters in the flat plain of the Hetao basin. Little is known about As and U concentrations in deep groundwaters, which has been intensively used for irrigation and drink. Incompatible distributions of groundwater As and U were found in deep groundwater from the piedmont areas of the Langshan Mountains. High U groundwater was mainly found in the recharge area of the alluvial fans, while high As groundwater in the flat plain. High As groundwaters were characterized by high Fe and Mn concentrations, and low Eh and low concentrations of Mo and NO_3^-. However, high U groundwaters had relatively high concentrations of Mo and NO_3^-, and low concentrations of Fe and Mn, which mostly occurred in oxic-suboxic conditions. Bedrock samples taken in the mountains, including schist, diorite, conglomerate, carbonate vein, granite, and phytite, had high As contents between 21.1 and 32.7 mg/kg, and U contents between 0.12 and 8.05 mg/kg. Arsenic was found to be enriched in pyrite and biotite in the bedrock, while U in calcite and biotite. Aquifer sediments were mostly transferred from mountain areas, where As was released from weathering of pyrite and biotite and fixed in the secondary Fe/Mn oxide minerals during sediment transport. In the flat plain, aquifers gradually developed to anaerobic conditions. In the reducing conditions, the aquifer sediments released the fixed As from the secondary Fe/Mn oxide minerals (Guo et al., 2011). Although precipitation of authigenic pyrite would scavenger dissolved As after Fe(III) and SO_4^{2-} reduction, dissolved As concentration were normally high due to the limited removal of As by pyrite coprecipitation (Guo et al., 2013). Groundwater U in the alluvial fans came from dissolution of carbonate minerals and weathering of biotite, and was transported as U(VI) carbonate complexes in the aquifers under oxic conditions (Spycher et al., 2011). However, U(VI) was reduced to U(IV) and fixed into sediments as groundwater flowed through the transition zone with Mn reduction (Banning et al., 2013). The incompatible distribution of groundwater As and U endangers drinking water supply, which requires further investigations.