



Chemical Characteristics and Geochemical Evolution of Groundwater in the North China Plain

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For the lack in gross of water resources and serious contamination of surface water in the North China Plain (NCP), groundwater has been the main water resources in the past decades. Studies of geochemical evolution in groundwater of the NCP can not only provide scientific data for sustainable utilization of groundwater resources, but also help us to comprehend hydrogeochemical processes in aquifers better. According to topography and hydrogeological settings, the NCP is divided into three zones, being piedmont alluvial fan-recharge zone (Zone I), central alluvial plain-intermediate zone (Zone II) and coast plain-discharge zone (Zone III). Based on zonation of the groundwater in the plain, characteristics of major components in shallow and deep groundwater of different zones were studied.

In general, concentrations of major components in shallow groundwater were higher than those in deep. For example, the maximum concentrations of calcium and magnesium ions in shallow groundwater were 121 mg/L and 98.0 mg/L, respectively, while the maximum concentrations of those in deep groundwater were 54.1 mg/L and 28.9 mg/L, respectively. The spatial distribution of sodium and potassium, chloride, sulfate and bicarbonate ions in shallow groundwater was much more patchy than that in deep. In shallow groundwater, concentrations of sodium and potassium, magnesium and chloride ions increased from Zone I to Zone III, while concentrations of calcium and bicarbonate ions decreased. Moreover, concentration of sulfate ion in shallow groundwater increased from Zone I to Zone II and slightly decreased from Zone II to Zone III. In deep groundwater, concentrations of sodium and potassium, chloride, sulfate and bicarbonate ions elevated from Zone I to Zone III, while concentration of calcium ion reduced all the way. Concentration of magnesium ion in deep groundwater decreased from Zone I to Zone II and slightly increased from Zone II to Zone III.

Temporal evolution indicated that major components in shallow groundwater had significantly increased since 1970s. Concentration of bicarbonate ion in shallow groundwater from Zone I had a maximum increase rate of 7.8 (mg/L)/year during 1995 and 2000. In deep groundwater from Zone I to Zone III, the increase rate was basically less than 0.7 (mg/L)/year and 0.4 (mg/L)/year, respectively. The main components in deep groundwater from Zone II showed great increases during 1985 and 1995, being 9.5 (mg/L)/year of chloride ion and 1.8 (mg/L)/year of magnesium ion. However, pollutant discharged by human activities and over-exploitation of deep groundwater which caused groundwater levels sharply declining and the dynamic and chemical conditions of groundwater changing, may attribute to the increases of major components in shallow groundwater and deep groundwater of Zone II.

Key words: The North China Plain, Characteristic, temporal; evolution; water-rock interaction