

## 基于水化学组分和环境同位素信息探讨山东德州深层承压地下水起源

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中文摘要:本文针对海河流域平原长期过量开采深层水导致地下水位不断下降,引发地面沉降等环境地质问题,选择德州深层水分布区作为重点研究区,以深层地下水化学组分及同位素作为主要研究对象,探讨深层地下水起源与更新性。研究表明,德州深层水主要形成于末次冰期盛期较寒冷的大气降水淋滤,在形成及径流过程中,遭遇较强烈的蒸发作用和阳交换作用,形成以HCO<sub>3</sub>-Na型水为主要成因类型,具有高氟、高钠、低钙、偏碱性的水化学特征,和氢氧稳定同位素低,氚含量低的同位素特点;深层地下水循环缓慢,更新能力较弱。

中文关键词:深层地下水 水化学组分 环境同位素 起源

## A Discussion on Deep Groundwater Origin of Dezhou in Shandong Province Based on Water Chemical Composition and Environmental Isotopic Information

**Abstract:** Aimed at solving the geo-environmental problems such as land subsidence resulting from continuous falling of water table due to over-exploitation, the authors selected the area of deep groundwater in Dezhou City as the key study area and took water chemical composition and environmental isotopic information as the study target to discuss origin and refreshing capacity of deep groundwater. The results show that deep groundwater in Dezhou was mainly derived from precipitation in the last glacial period characterized by cold climate. During its formation, it had the characteristics of leaching and was affected by evaporation and cation exchange action. Later, it was interfered by many times of seawater invasion. It was dominated by HCO<sub>3</sub>-Na type water characterized by high fluorine, high sodium, low calcium and alkalinity, together with low concentrations of hydrogen and oxygen isotopes and low tritium content. The deep groundwater in Dezhou is recycled slowly and its refreshing capability is weak.