Groundwater chemistry and origin of Na-HCO_3 type of water from northern Primorye (Russia)

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In this paper we present new data on groundwater chemistry of Lastochka spa located in the northern part of the Primorye region, in the south-western part of Ussuri River catchment. Groundwater samples were collected over a 3 year period. Two types of groundwater are distinguished in this area: the first one is fresh water with low mineralization (TDS is varied from 0.2 to 0.4 g/l), pH 7.3-7.5 and the second one is high mineralized water (TDS is varied from 3.7 to 4.7 g/l), pH 5.8-6.4. Both types of water are used like a source of potable bottled water and belong to Na-Ca-HCO_3 type. The pressure CO_2 reaches 2.6 atm in the high mineralized water but only 10^{-2} atm in fresh water. The contents of Na^+, Ca^{2+}, Mg^{2+}, HCO_3^-, Fe^{2+} are drastically increased in high pCO_2 springs, while SiO_2 content is depleted relative to fresh waters. The contents of trace elements in high pCO_2 water are considerably higher then in fresh water from this area. The concentration of trace elements in high CO_2 spring are: Cu – 38.21, Pb – 0.25, Zn – 67.64, Be – 0.49, Sr – 6260, Rb – 171.05, Li – 1547, Ba – 3260, Cs – 47.37, Ag – 0.25, Mo – 0.06 μg/l.

Obtained data on the REE concentrations in groundwater indicate that in all samples REE contents becomes greater with increasing atomic number. It is clearly observed the negative Ce anomalies and positive Eu anomalies that reflects the reducing conditions of the underground environment where the both types of groundwater evolved.

Our studies of the Lastochka spa groundwater hydrochemistry together with detailed investigation of drill core prove that both types of groundwater are originated from meteoric water and water – bedrock interaction has played a main role in forming chemical composition of waters. However, the role of mantle CO_2 gas is crucial for high mineralized groundwater origination. This type of groundwater is evolved only during water-rock-gas interaction. Drastic accretion TDS in high mineralized water is induced by diffusion deep CO_2 gas via faults into groundwater. The violent difference in the trace element concentration in both waters is caused by more intensive weathering of primary minerals in presence CO_2 gas. This confirmed the area of high mineralized water circulation. This type of groundwater is found only in the vicinity of the shatter zone.

Groundwater modeling for the phreatic-confined aquifers system in the Huolinhe River Basin, Inner Mongolia, China

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The Huolinhe River Basin is located in the transitional zone from the south part of the Great Xinganling Mountain to the Inner Mongolia Plateau, with a total area of 1276.59 Km^2. The Huolin City, which is the main city in the Huolinhe River Basin, has a land area of 585.00 Km^2 and a population of 68.90 thousands. In this area, the average annual precipitation is about 400 mm, and the average annual evaporation is about 700 mm. The city relies heavily on groundwater for water supply. The Huolinhe opencut coal mine within this area has a total of 12.90 billion tons coal resources within an area of 64.56 Km^2. Many power stations are seted up using the rich coal resources. The rapid ecomomic growth and industrialization in Huolin City resulted in the shortage of the groundwater resources, so the evaluation of the groundwater resources of this area is of great significance. In previous studies, this area was divided into some subareas, according to the boundaries of the administrative districts, to evaluate their groundwater resources in different aquifer respectively, but the separation resulted in some artificial error. For the first time, the phreatic aquifer and the confined aquifer in this area are considered as a whole system in this paper, so such error can be avoided. The 3-dimensional model which describes the characteristics of the storage and the flow of the groundwater is built according to the multilayer aquifers system with large area and complex condition. The parameters of the model are identified on the base of the fine division by GMS4.0 which is the international common-used standard software for the numerical simulation of groundwater. Furthermore, some different exploitation alternatives of the area are evaluated. The results provide evidence to the building of management model of water resources in the future, and give some reasonable advices of exploitation to the project of economic development and sustainable development.

According to the simulation results, the drainage of the opencut coal mine amounts to about 1.44 and 0.16 million m^3 in Saerhure district and Dundenol district, respectively. The exploitable groundwater are about 3.09 and 0.98 million m^3 for the phreatic aquifers in Saerhure district and Dundenol district, respectively, and about 1.04 million m^3 for the confined aquifer in Dundenol district.