

The temperature evaluation of the buried hill geothermal reservoirs in the Jizhong Depression, Bohai Bay Basin, China

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The temperature of geothermal reservoirs is the key factor influencing the exploration and development of geothermal resources. It is an effective method for evaluating the feasibility of commercial exploration and development of the geothermal reservoirs to predict the temperature of deep geothermal reservoirs using the analyzed macroelements of shallow groundwater. The Jizhong Depression is located in the western Bohai Bay Basin, eastern China. The deep strata is mainly composed of carbonate buried hill and the shallow strata is mainly siliciclastic deposition. In the present work, we investigated the geochemical characteristics of shallow groundwater and reservoir temperature features of three geothermal reservoirs in the Jizhong Depression, including the Ordovician, the Cambrian, and the Precambrian Wumishan Formation, using the Giaggenbach diagram and geothermometers. The results showed that the underground water in Jizhong Depression can be divided into three types: type I, Cl-HCO₃-Na groundwater; type II, Cl-Na groundwater; type III, Cl-Na-Ca groundwater. By using the Giaggenbach diagram, type II and type III groundwater was identified as the partially equilibrated waters, whose geothermal reservoir temperature can be calculated based on the cationic geothermometers. On the basis of the features of ion adjustment in the circulation of groundwater, the geothermal reservoir temperature in the shallow strata was determined by the K-Mg geothermometer, the geothermal reservoir temperature in the deep strata was calculated using the Na-K geothermometer. Moreover, some special water samples with high Ca²⁺ concentration was estimated by the Na-K-Ca geothermometer in our conducted analyses. The ranges of the calculated temperature of the shallow strata and the deep strata are 119-146 °C and 151-172 °C, respectively. In order to verify the accuracy of the predictions, the results of the shallow geothermal reservoir temperature were compared with the temperature from the drilling test. The agreement between the predicted and drilling results was encouraging. The analysis workflow and calculation data obtained in this work are contribute to the evaluation of the temperature field and the exploration and development of the geothermal resources in the Bohai Bay Basin.