Abstract

Isotopic investigations combined with geothermal applications represent powerful tools for the exploration of groundwater potential as a drinking or geothermal resource. This Ph.D. Thesis combines both approaches, environmental and radioactive isotopes together with temperature data in deep aquifers, in order to enrich and update the knowledge concerning the aquifer recharge processes in the Aquitaine Basin (France) and the aquifer recharge processes and geothermal potential in the Bohemian Cretaceous Basin (Czech Republic).

Stable isotopes (^{18}O, ^{2}H, ^{13}C) combined with radioisotope data (^{14}C, ^{3}H) are used to estimate the recharge timing and climatic conditions prevailing during the infiltration from the Late Pleistocene up to modern time. The character of groundwater recharge and regime are necessary to generate relevant source data for the accurate modelling of complex groundwater systems. Three groups of groundwater recharge types can be distinguished throughout Europe – (i) continuous recharge and (ii) interrupted recharge during Last Glacial Maximum and (iii) a group corresponding to particular recharge conditions.

The contrasted geographic and climate conditions at both study sites in France and the Czech Republic have entailed a great heterogeneity of the recharge conditions and processes. Southern France, with generally mild climatic conditions during the last 40 ka BP, did not experienced considerable hiatus in groundwater recharge. The residence time of groundwater in the Bohemian aquifers is estimated about 11 ka BP at the maximum but the depletion in the stable isotopes suggests that this groundwater originates in the melting of the north European ice sheets after the Last Glacial Maximum period, i.e. 18-20 ka BP. Further investigations on both stable and radioactive carbon isotopes indicated numerous groundwater interactions within the reservoir that were used to delineate the carbon origin within the Bohemian aquifers.

Information on groundwater geochemistry was supplemented in the Czech case study by geothermal data in order to improve our knowledge of groundwater flow and dynamics. More than one hundred of temperature records from well-logging measurements were used to assess the geothermal gradient in the Bohemian Cretaceous Basin which is the most promising heat accumulation within the country. Many phenomena can affect the thermal field in the region. Vertical groundwater flow and variations in the lithology and the topography lead to a complicated areal distribution of the geothermal gradient and the heat flux which is dominantly controlled by groundwater. Shallow tectonic structures and numerous volcanic rocks exercise an influence on groundwater flow and therefore exert a secondary effect on the thermal field. The geothermal investigation provided useful information on the geothermal resources within the region but also represents an important tool for understanding groundwater flow, and for constructing realistic hydrogeological models in such a complex geological, tectonic and geothermal context.

Key words: deep aquifers, isotopic hydrogeology, residence time, geothermal potential, heat flux