Abstract

The thesis deals with the study of highly permeable porosity and the potential for karstification in the area of the East Bohemian Cretaceous synclines, which are of great importance for water supply. The susceptibility of the rocks to karstification was studied by taking cores and determination of their calcite content and by leaching the cores in 10 % HCl and monitoring of rock disintegration after leaching. A scanning electron microscopy and elemental mapping by microprobe were used to understand the structure and composition of the rock. The nature of the inflow zones to the boreholes was studied by evaluating available well logging data, particularly acoustic well logging, inflow data to the boreholes and by leaching rock samples from cores taken from the depth intervals where inflows occurred.

A total of 247 cores taken from both boreholes and surface outcrops were studied. Only 5 % of the samples from the Turonian B, Ca, Cb aquifers that disintegrate from more than 50 % after leaching will form karst conduits in tectonically intact rock. This representation is much lower than in the Jizera Formation in the western part of the Bohemian Cretaceous Basin. Only a small fraction of the samples disintegrate if calcite content is below 78 %, the majority show no or very little disintegration. Only when the calcite content in the samples exceeds 80 % do the samples disintegrate completely or largely after leaching. The porosity after leaching exceeds 50 % in 26 % of the samples. Even a high calcite content thus does not lead to the disintegration of the rock after leaching, but to the formation of extremely porous material with low density and thus relatively low resistance to erosion. The highly porous samples are held together by a microscopic foam-like structure of precipitated siliceous matter released probably during diagenesis from opal-rich marine sponge needles.

The location and character of the main inflows to the wells was studied in 65 wells. Inflows occur on average from only 10 % of the aquifer thickness. The inflows have a yield of up to tens of l/s per meter of inflow zone. Evaluation of acoustic logging data showed that inflows from subhorizontal caverns dominate (70 %). Several mechanisms for the formation of open and highly permeable fracture-guided conduits have been newly described: 1) Calcite dissolution from layers with $CaCO_3 \geq 80\%$ and after residue washout expansion into subhorizontal caverns; 2) Calcite dissolution of subvertical calcite veins; 3) Calcite dissolution of calcite-rich fractured zones on subvertical fracture bundles where individual fracture surfaces are only a few centimeters apart. After the formation of a steep hydraulic gradient (e.g., in the vicinity of a valley or during pumping at a well), small fragments of highly porous, low-density material are washed out of the fracture zones to form subvertical open (gaping) fractures, often with sharp-edged walls, which give the false impression of having been formed by tectonic extension. Based on tracer tests, it is evident that the open fissures form a large interconnected system through which groundwater flows at a speed of hundreds of metres per day over a distance of more than 2 km. Comparable flow velocities have been found in open fractures in siliciclastic-carbonate rocks in Minnesota and Wisconsin in the USA and in the Sherwood Sandstone in the UK.

The most permeable porosity in the East Bohemian Cretaceous synclines is thus of karstic origin, although tectonic rock disturbance is also necessary for the formation of channels in subvertical fracture zones. This is a ghost-rock karst, where in the first phase the calcite is slowly leached from the rock by groundwater flowing slowly in pores and narrow fissures. It is only in the second phase, when a steep hydraulic gradient develops, that the residuum is washed away, creating gaping and dm-wide open bedding surfaces or subvertical fractures with extreme flow rates of up to 90 l/s.