Geophysical Research Abstracts
Vol. 19, EGU2017-13504, 2017
EGU General Assembly 2017

Origin of karst conduits in calcareous sandstone and carbonate-silicate rocks: Complex role of insoluble material

Jiri Bruthans (1,2), Frantisek Balak (1), Jana Schweigstillova (3), and Jan Vojtisek (1)

(1) Charles University, Faculty of Science, Prague 2, Czech Republic (bruthans@natur.cuni.cz), (2) Czech Geological Survey, Klárov 3, Prague 1, 118 21, Czech Republic , (3) Institute of Rock structure and Mechanics CAS v.v.i., V Holešovičkách 41, 182 09, Prague 8, Czech Republic

Carbonate karst is best developed in high-grade limestones and majority of the studies is focused on these rocks. Features developed by dissolution of calcite cement in quartz sandstones and dissolution of various carbonate-silicate rocks are studied far less frequently. Unlike in common karst, the insoluble residuum has to be washed out after dissolution to create high-permeability conduits in these rocks.

Aquifers in a Bohemian Cretaceous Basin (BCB), the most important hydrogeological basin in the Czech Republic, consist mainly of quartz and calcareous sandstones to siltstones. These rocks are intercalated by thin layers of calcite-cemented sandstone and low-grade limestone, the latter sometimes partly impregnated by a secondary silica. Results of tracer tests show a high flow velocity in some of the aquifers. Springs with flow rate up to 500 l/s and wells with yield up to 200 l/s occur in these rocks. Dissolution features in BCB were however not yet studied in detail.

For identification and characterization of rocks prone to karstification, 350 cores were sampled mostly from boreholes but also from rock outcrops in several areas of BCB. Cores were taken from intervals where: (i) high carbonate content was expected, (ii) conduits and enlarged porosity was observed in rock outcrops or wells, (iii) inflows to boreholes were determined by well logging. Calcium carbonate content was determined by calcimetry in all cores. All cores were leached in hydrochloric acid to observe the degree of disintegration after removal of calcite, which was far dominating portion of total carbonate. Polished sections were prepared from selected cores and Ca, Si, Na, K, Al content was automatically mapped by microprobe to visualize the calcium, silica, feldspar and clay mineral distribution in cores. Conduits were photo documented in the field.

Two types of sediments with distinct disintegration characteristics were observed:

(i) In sandstone composed of quartz grains cemented by calcite the complete disintegration occurs when calcite content exceeds 30-50%. Such calcite-rich layers are mostly few tens of cms thick and are enclosed in quartz sandstone. Groundwater flow dissolves calcite cement and turns the rock into cohesion-less sand. Sand is consequently washed out by headward erosion in drainage areas forming high capacity conduits within the sandstone.

(ii) In carbonates containing secondary silica which form reinforcing structure, even 70-80% calcite content may not be sufficient for rock disintegration during leaching. Disintegration occurs only on tectonically heavily fractured zones, where secondary silica structure is fragmented.

It was found that inflows into wells are often associated with zones prone to karstification. Results clearly show that form of insoluble material is critical for karstification potential. Insoluble grain size defines minimum flow velocity needed to excavate the conduits in dissolved residuum. Impregnation by secondary silica needs to be tectonically fragmented prior conduits can occur.

Research was funded by the Czech Science Foundation (GA CR No. 16-19459S) and Review of groundwater resources (Ident. No. 155996).