M U N I

COMMENTARY TO HABILITATION THESIS[1]

Anthropogenic impact on the groundwaters between Bohemian Massif and Western Carpathians

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Groundwater, as the world's second largest reservoir of fresh water, is essential for the sustainable development of human society. The geological setting at the contact between the Bohemian Massif and the Western Carpathians is characterized by a variety of different rock formations, including crystalline formations, basin structures, and platform sediments. In a relatively small area, we can observe all the basic types of aquifer structures with their typical characteristics of groundwater formation, circulation, and drainage. Many of them form groundwater bodies that are important for the development and sustainability of human society.

Geological processes in the area have also led to the formation of significant raw material deposits. Their historical extraction, including both surface and underground mining methods, gradually affected the groundwater regime and led to the establishment of a new state influenced by anthropogenic activity. For the cases of gravel and sand mining, being the typical example of open pit mining, the marked local disruption of groundwater table has been characterised. Changes in the aquifer water balance due to the evaporation losses from open water table reduces sustainable groundwater resources. A comprehensive analysis of the present and future stages requires 3-D numerical groundwater flow modelling, preceded by extensive field measurements. These include the groundwater levels and surface discharges measurements for model calibration, determination of ET, evaluation of hydrochemistry for SI calculations and minerals precipitation using geochemical modelling, and possibly the evaluation of H and O stable isotopes contents.

The underground mining affect not only the deep aquifers directly surrounding the mine works, but also the shallow overlying aquifers and other water elements, including the surface streams and rivers. The hydraulic connection of mine works with shallow aquifers and surface water is via natural tectonic structures or mining induced fractures, up to 50% of mine water may originate from surface stream losses. The use of 3-D numerical groundwater modelling tools to compare the pre-mining and post-mining stages needs specific data set. The sequential stream discharge measurements at boundaries of geological units and fault structures were used for model calibration, instead of classical approach using borehole groundwater levels.

Stream thermometry was proved to be an effective tool to delineate the preferential geological features important for groundwater flow in non-homogenous crystalline rock complex in mining areas. Statistical approach of aquifer drainage positions requires extensive field data set; combination of T and EC values measurement has proven to be suitable.

Industrial growth and increasing population density has brought significant risks to the quality of groundwater due to the use of toxic substances. Chlorinated solvents, particularly chlorinated ethenes, are among the most widespread groups of groundwater contaminants. Despite of their artificial origin, they undergo natural attenuation processes, including the decay. For cases where the reductive dechlorination is the principal process of their degradation, values of first-order decay rates vary

[1] The commentary must correspond to standard expectations in the field and must include a brief characteristic of the investigated matter, objectives of the work, employed methodologies, obtained results and, in case of co-authored works, a passage characterising the applicant's contribution in terms of both quality and content.

significantly. Redox zones delineation, based on spatial analysis of redox sensitive species concentrations, and the use of analytical modelling, have clarified the differences in degradation of primary PCE and TCE to DCE and VC among sites. The PCE and TCE degradation rates were found one order of magnitude higher under sulphate reducing conditions, while the VC degradation have been found to more effective under Fe(III) reducing conditions.
In the last decades, geothermal energy, a form of renewable energy, is gaining popularity among many EU countries. The aquifers contained within Mesozoic sediments are of particular significance within the field of geothermal energy research, since they exhibit both increased permeability and a considerable spatial extent. Anthropogenic risks are primarily associated with their possible excessive exploitation, resulting from insufficient knowledge about the formation of thermal waters. Understanding the processes of thermal water formation needs a complex of methodological approaches, including 3-D geological setting interpretation, hydrochemistry evaluation including suitable geothermometers (in e.g. Na–K–Mg), H and O stable isotopes evaluation, and finally advanced 3-D numerical groundwater flow modelling with variable density flow (in e.g. MODFLOW-2000/MT3DMS coupled in SEAWAT).

The list of seven selected publications included in habilitation thesis is listed below. List includes 5 papers in WOS database, and 2 ISI Proceedings. The author's contribution is divided into the following sections: scientific work (theoretical work, field measurements, data evaluation), supervision of students, manuscript writing and research direction.

[P1][2] VANICEK, Petr, Adam RICKA, Tomas **KUCHOVSKY**, Bibiana PASTERNAKOVA, Katerina CHROUSTOVA a Karel SUHAJDA. Sustainable groundwater resource extraction influenced by changing climate and pit lake expansion in East Bohemia, Czech Republic. *Journal Of Hydrology-Regional Studies* [online]. 2025, **59**(102400, Article 102400). ISSN 2214-5818. doi:10.1016/j.ejrh.2025.102400

Scientific work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
25	30	25	25

[P2] **KUCHOVSKY**, Tomas, Adam ŘÍČKA a Jaroslava ČERVENKOVÁ.Impact of Gravel Pits on Ground water: Case study of Gravel Pits near the Mohelnice City, Czech Republic. In Mine Water and the Environment PROCEEDINGS, 10th International Mine Water Association Congress, June 2-5. 2008, Karlovy Vary, Czech Republic. Ostrava: VŠB - Technical University of Ostrava. 2008, 69 - 72, ISBN 978-80-248-1767-5.

Scientific work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
75	0	90	100

[2] Bibliographic record of a published scientific result, which is part of the habilitation thesis.

[P3] **KUCHOVSKY**, Tomas, David GRYCZ a Michala DRÁBOVÁ. Regional Impact of Mining on Stream Drainage Characteristics in the Rosice - Oslavany Coal Mining District, Czech Republic. In Mine Water and the Environment PROCEEDINGS, 10th International Mine Water Association Congress, June 2-5. 2008, Karlovy Vary, Czech Republic. Ostrava: VŠB - Technical University of Ostrava. 2008, 155 - 158, ISBN 978-80-248-1767-5.

Scientific work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
80	0	90	100

[P4] RICKA, Adam, Tomas **KUCHOVSKY**, Ondra SRACEK a Josef ZEMAN. Determination of potential mine water discharge zones in crystalline rocks at Rozna, Czech Republic. *Environmental Earth Sciences* [online]. 2010, **60**(6), 1201–1213. ISSN 1866-6299. doi:10.1007/s12665-009-0261-8

Scientific work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
40	20	30	30

[P5] **KUCHOVSKY**, Tomas, Adam RICKA a David GRYCZ. Using Numerical Modeling to Understand the Discharge from a Flooded Abandoned Underground Mine. *Mine Water And The Environment* [online]. 2017, **36**(4), 606–616. ISSN 1616-1068. doi:10.1007/s10230-017-0455-3

Scientific work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
80	0	90	100

[P6] **KUCHOVSKY**, Tomas a Ondra SRACEK. Natural attenuation of chlorinated solvents: a comparative study. *Environmental Geology* [online]. 2007, **53**(1), 147–157. ISSN 0943-0105. doi:10.1007/s00254-006-0628-z

Scientific work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
90	0	80	80

[P7] CHROUSTOVA, Katerina, Adam RICKA, Bibiana PASTERNAKOVA, Tomas **KUCHOVSKY**, Thomas R. RUDE a Josef ZEMAN. Identification of deep Czech Republic-Austria transboundary aquifer discharge and associated river chloride loading. Environmental Earth Sciences [online]. 2024, 83(12, Article 366). ISSN 1866-6299. doi:10.1007/s12665-024-11670-7

Scientific work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
25	30	25	25