In situ measurement and modeling of physicochemical parameters at discharging thermal water – Experimental study 1

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ABSTRACT
Thermal springs are the terminal points of groundwater flow systems, and transfer allochthonous water onto the surface. The variation of physicochemical parameters at the discharge location of thermal springs is a significant influencing factor in the formation of precipitates. In this study, a canalized thermal spring outflow of the Buda Thermal Karst system was investigated in the tunnel of Gellért Hill, Budapest, Hungary. On the canal walls close to the outflow the development of a red, long filamentous bacterial biofilm can be observed. Further along the canal it changes into lighter red, crystalline but not so hard precipitate and then into white hard, dominantly carbonate crystalline precipitate. These changes indicate that the physicochemical parameters change significantly in this section of the canal. So the aim of our study was to determine how the changes of the physicochemical characteristics of the emerging spring water lead to the formation of the observed precipitates in the canal. The temperature, specific electric conductivity, pH, dissolved oxygen content, redox potential, concentration of major ions, dissolved carbon dioxide content, concentration of radium-226, uranium-234+238 and radon-222 were determined. Discharge volume and flow velocity of the flowing water were also measured. The experiment was conducted twice and the results were also evaluated by reactive transport modeling with PHREEQC. It is found that degassing of CO_2 is a key process controlling the water chemistry, including pH. Ingassing of oxygen also occurs and affects the redox state of the water along the canal. The conclusions of this study were used for the planning of further investigations to examine the formation and evolution of the red and white precipitates.
The research was supported by the NK 101356 OTKA research grant and by the European Union and the State of Hungary, co-financed by the European Regional Development Fund in the project of GINOP-2.3.2.-15-2016-00009 ‘ICER’.

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