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Migration of essential microelements in different types of mineral waters: Examples from Serbia

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ABSTRACT

Physical and chemical characteristics of mineral waters on the territory of Serbia were examined in this study, in order to identify the main factors that influence the hydrogeochemical behavior of selected group of essential microelements. Over 130 mineral water samples were collected, from different types of aquifers (igneous, metamorphic and sedimentary rocks) and from different hydrogeological units. Temperature, pH and conductivity were measured on raw samples *in situ*, while major anions and cations, as well as microelements (F, B, Li, K, Sr and Si) were determined in the laboratory. Multivariate statistical methods (factor analysis, Q-mode cluster analysis and R-mode cluster analysis) have been applied to 110 mineral water samples, with the charge balance errors within ±5%. Factor analysis extracted three factors, which explain 67.4 % of the total variance in the analyzed dataset. R-mode cluster analysis confirmed these results. The interpretation of obtained factors has indicated that several hydrogeochemical processes are important for the migration of examined microelements. These are: the influence of highly mineralized, hydrochemically mature groundwaters; weathering of schists, granitoid intrusions and Tertiary volcanic rocks; cation exchange; dissolution of carbonate rocks; the effect of non-carbonated thermal waters on silicate minerals. The mechanism of these processes has been studied and validated on a certain number of representative examples of mineral waters. Hierarchical cluster analysis has identified four groups (clusters) and eight subgroups, representing different hydrochemical types of mineral waters, which can be regarded as a new approach to classification of Serbian mineral waters. The effect of above mentioned hydrogeochemical processes on each cluster, i.e. water type, has also been examined. Pattern of spatial distribution of studied microelements has been perceived, as well as the range of variation of their concentrations. Hydrogeochemical modeling has been applied on a group of chosen mineral water samples, in order to calculate the most probable ion species of the analyzed microelements. By systematizing the results of this study, the favorable hydrogeochemical conditions for migration of each of the six considered microelements were defined.