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Editorial

Geochemistry of Water and Sediment

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Access to drinking water is one of the largest problems of modern times, and water pollution is a growing problem worldwide. Increased concentrations of different toxic substances, especially heavy metals, affect biodiversity and are hazardous for human health. Sediment may act as a sink for a huge number of toxic substances and should, therefore, be investigated in addition to water, as it contains a record of previous pollution. Geochemical investigations of aquatic sediments in freshwater and marine environments present excellent insights into the state of pollution of investigated water bodies and their ecosystems. The chemical composition of sediment is informative, both in investigations of mineral resources of a particular region for mining purposes and in tracing contamination from different sources. Pollution affects all sources of drinking water—ground, spring, river, and lake. The interaction of water and sediment is of special importance, as sediment can also release heavy metals and act as a source of pollution.

Systematic geochemical investigations of river sediments and their quality in the broader region of SE Europe started in 1989 in Croatia [1], with pioneering study of heavy metals in sediments of the Krka River Estuary, Croatia. This study was the first attempt to determine anthropogenic influence in sediments. First systematic assessment of multi-elemental composition of stream sediments for evaluating sediment quality guidelines in a large drainage basin of this region was performed in 2005 and 2007 on example of Kupa River drainage basin (Croatia, Slovenia, Bosnia and Herzegovina) [2,3]. During the following years, Croatian scientists expanded their research with introducing the new fast and efficient method of magnetic susceptibility applied on sediment contamination with heavy metals research in Croatia and nearby countries [4]. Their research and collaboration expanded through the region and among other we highlight the fruitful collaboration with team from Centre of Excellence of University of Belgrade, Serbia. Research expertise of Croatian and Serbian partners is complementary and currently joint research on example locations in Croatia (Kupa River) and Serbia (Vlasina River) are under way. Until now it resulted in published paper on thematic of geochemical fractionation and risk assessment of potentially toxic elements in sediments from Kupa River, Croatia [5]. Croatian partners are disseminating to Serbian partners their experience and knowledge about river sediment research and monitoring, as well as about introducing of magnetic methods, while Serbian partners are disseminating to Croatian partners their experience in geochemical fractionation and risk assessment of potentially toxic elements in sediments.

Intensive collaboration between Croatian and Serbian scientists resulted in joint idea to launch a Special Issue of Water focusing on geochemistry of water and sediment. This idea was accepted from Editorial Board of Water and Dr. Stanislav Frančišković-Bilinski from Ruđer Bošković Institute, Zagreb, Croatia and Dr. Sanja Sakan from Centre of excellence of the University of Belgrade, Serbia, have been confirmed as Editors of the Special Issue under the title "Geochemistry of Water and Sediment", within the section "Aquatic Systems—Quality and Contamination". The purpose of this Special Issue was to publish original, high-quality research papers, as well as review articles, addressing recent advances in water and aquatic sediment research, new methods and developments

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in monitoring, as well as legislative development. This Special Issue was announced in May 2019 and opened for submissions with a deadline of 30 December 2020. However, due to the pandemic and lockdown over most of the world in spring 2020, the deadline was extended until 30 November 2020, when submissions for this Special Issue were closed. A total of 12 papers were submitted for publication and they have undergone a scrutinized review process. Eventually, ten papers passed the rigorous review by at least two recognized international reviewers and extensive editorial checks. The papers compiled in this Special Issue show a wide variety of topics:

Gerselish et al. [6] investigated composition of sedimentary organic matter across the Laptev Sea Shelf presenting evidences from rock-eval parameters and molecular indicators. In their study they aimed to identify the sources, distribution and degradation state of organic matter (OM) stored in the surface sediments of the Laptev Sea (LS), which receives a large input of terrestrial carbon from both Lena River discharge and intense coastal erosion. Molecular-based degradation indicators show a trend to more degraded terrestrial OC with increasing distance from the coast corroborating with RE results. However, much less variation of the degradation markers down to the deeper sampling horizons was observed.

Kolpakova et al. [7] investigated the distribution profile of chemical elements during the last 13 thousand years from the sediments of the semi-arid Maloye Yarovoe Lake (Western Siberia, Russia). Their research helped to understand the chemical evolution of this lake, which is the most widespread chemical type of saline lake (Cl-Na) on the territory of Kulunda Steppe in south of Western Siberia. They reconstructed several changes in the state of the lake, through which it has gone during the past. The results of sequential extraction of elements correspond to chemical changes occurred in a certain time of the lake state by changing in their distribution level and fraction type along the core. The results of lake water evaporation and organic matter degradation modelling performed in water–rock interaction processes in combination with biogeochemical reactions affect drastically not only the migration features of elements in water and sediments, but also the type of mineral crystallization in lake sediments.

Dalu et al. [8] investigated metal distribution and sediment quality variation across sediment depths of a subtropical Ramsar declared wetland. Significant differences in nutrient (i.e., N, P) and metal (i.e., K, Mg, Na, Fe, Cu, B) concentrations were found across study sites, whereas nutrients (i.e., N, P) and metals (i.e., Ca, Mg, Fe, Cu, Zn) were significantly different with sediment depths. When compared against Canadian sediment standards, most of the assessed metals were within the "no effect" level across the different sites and depths, while the K, Ca, and Mg concentration and enrichment showed extreme contamination across all sites and depths. All sediments across the different sites and sediment depths indicated deterioration of sediment quality. These results provide baseline information for the general management of the Nylsvley Wetland in relation to sediment metal pollution.

Sakan et al. [5] investigated geochemical fractionation and risk assessment of potentially toxic elements in sediments from the Kupa River, Croatia. Their study investigated the quality of Kupa River sediment using sequential extraction, ecological risk, and contamination indexes, determination of magnetic susceptibility of sediments, and statistical methods. BCR sequential extraction technique, proposed by the Community Bureau of Reference, was used for evaluating various element-binding forms. Most of the elements were considered to be immobile due to the high availability in the residual fraction. Lead was present mainly in the reducible fraction, while more easily mobile and bioavailable forms were predominant for cadmium and barium. The most toxic element, Cd, is the main contributor to the total potentially ecological risk. Increased values of contamination factors have been observed for Zn, Cr, and Ba in some localities. Results of the comparison of element contents in sediments in a 15-year period (2018 vs. 2003) indicated that the situation with toxic element content in sediments along Kupa River improved for most of its course. Using the example of Kupa River sediments, it was shown that the magnetic susceptibility method is excellent in detecting increased values of Cr.

Thin et al. [9] investigated a dual source of phosphorus to lake sediments indicated by distribution, content, and speciation in the example of Inle Lake. In their study, grab and core sediments from Inle lake were collected and analyzed for their water and organic matter (O.M.) contents. Total phosphorus (TPSMT) and P fractions, namely inorganic-P (IP), organic-P (OP), P bound to Al, Fe and Mn oxy-hydroxides (Fe-P), and calcium-bound P (Ca-P) were determined by a sequential extraction procedure. Concerning P forms, the overall abundance sequence in grab sediments was IP >> OP and Ca-P $\geq$ OP > Fe-P, whereas in core sediments it showed marked differences with depth and between sites. The relative abundance of the inorganic species (Ca-P, Fe-P) was controlled by the mineralogy of the sediments. While the TPSMT distribution pointed to an increased anthropogenic input, the relative abundance of P species provided information on the P origin, incorporation processes, and evolution over time. This information, combined with chemical and mineralogical data, permitted to identify two different P sources: the agricultural input in the floating gardens area and the detrital input related to soil erosion.

Glaser et al. [10] investigated particle-associated pollutant transport to identify in-stream sediment processes during a high flow event. Their study aimed to identify particle exchange processes that contribute to the transport of suspended particles during flood events. An urban high-flow signal was tracked in high temporal resolution at two sampling sites in the Ammer River (South-western Germany). Samples were analyzed for turbidity, total suspended solids concentrations (TSS), particle-size distribution, organic carbon, and PAHs (Polycyclic aromatic hydrocarbons). Maximum discharge and the highest TSS occurred nearly simultaneously at the upstream sampling site, whereas a temporally shifted course was observed for downstream. The total load of particles was similar, yet a decrease of PAH mass (~28%) and an increase of the particulate organic carbon (POC) content (~3.5%-points) occurred. The signal of remobilized riverbed sediment increases downstream and leads to well-established, robust linear correlations between TSS and PAHs. Their study highlights that riverbed sediment acts as intermediate storage for contaminated particles from upstream sources that shape, together with the fresh urban input, the "particle signature" of suspensions moving through catchments during high discharge conditions.

Slukovskii et al. [11] investigated hydrochemistry and recent sediment geochemistry of small lakes of Murmansk, Arctic Zone of Russia. It was found that the water of the studied lakes in Murmansk belong to the sodium group of the chloride class and to the calcium group of the hydrocarbonate class. Compared to the background level, elevated pH, concentrations of the main cations of alkali and alkaline-earth metals, N compounds, total dissolved solids, and heavy metals were found in the lakes, which indicate exposure to anthropogenic impacts. The sediments of the lakes, composed of organomineral and mineral silts, also have an elevated content of heavy metals compared to the background. Based on the calculated pollution load index and geoaccumulation index of the sediments, the studied water bodies in Murmansk can be classified as lakes with heavy and extremely heavy pollution levels.

Zhang et al. [12] investigated source and mobilization mechanism of iron, manganese and arsenic in groundwater of shuangliao City, Northeast China, by statistical methods and spatial analysis. Excessive levels of Fe, Mn, and As are the main factors affecting groundwater quality in Songliao plain. Their results show that the source of Fe and Mn in the groundwater of the platform is the iron and manganese nodules in the clay layer, while, in the river valley plain, it originates from the soil and the whole aquifer. The TDS, fluctuation in groundwater levels and the residence time are the important factors affecting the content of Fe and Mn in groundwater. The dissolution of iron and manganese minerals causes arsenic adsorbed on them to be released into groundwater. Their study provides a basis for the rational utilization of groundwater and protection of people's health in areas with high iron, manganese and arsenic contents.

Cai et al. [13] investigated spatiotemporal variations in seston C:N:P stoichiometry in a large eutrophic floodplain Lake (Lake Taihu). Their research tried to answer the question:

Do the Sources of Seston Explain Stoichiometric Flexibility? Although sources of seston are much more complicated in lakes compared to oceans, the influences of different sources on the spatiotemporal variations in seston stoichiometry are still underexplored, especially in large eutrophic floodplain lakes. Here, they investigated seston stoichiometric ratios across a typical large eutrophic floodplain lake (Lake Taihu, East China) over one year. In addition, they used the n-alkane proxies to examine the influence of the seston source on seston stoichiometry variation. Throughout their study, the average value of the C:N:P ratio of 143:19:1 across Lake Taihu was close to the canonical lake's ratios (166:20:1). Their study, thus, highlights the utility of multiple-combined n-alkane proxies in addition to simple C:N ratios to get more robust source information, which is essential for interpreting the spatiotemporal variations in seston stoichiometric ratios among eutrophic floodplain lakes and other freshwater ecosystems.

Wang et al. [14] investigated hydrochemistry and its controlling factors of rivers in the source region of the Nujiang River on the Tibetan Plateau to reveal its hydrochemical characteristics and to evaluate the water quality for irrigation purposes. Based on 39 samples, the results revealed mildly alkaline pH values and total dissolved solids (TDS) values ranging from 115 to 676 mg/L, averaging 271 mg/L. Major ion concentrations based on mean values (mg/L) were in the order of $Ca^{2+} > Na^{+} > Mg^{2+} > K^{+}$ for cations and $HCO_3^{-} > SO_4^{2-} > Cl^{-} > CO_3^{2-}$ for anions. Most hydrochemical types were of the Ca–HCO3 (~74.36%) type. Cluster analysis (CA) suggested that the hydrochemical characteristics upstream of the main stream of the Naqu were obviously different from those from the middle and downstream of the main stream and its tributaries, which is controlled by carbonate and silicate weathering.

Finally, we can be very proud with the success of our Special Issue and with the quality and wide variety of scope of accepted papers—from marine, lacustrine, and river environments from different parts of the world and different climate zones. As guest editors we learned a lot from the whole process of launching of our Special Issue and handling manuscripts and doing all other tasks, which could be useful for our future editorships and our future publications.

The Guest Editors are looking forward to the continuation of this Special Issue trough the new Special Issue "Geochemistry of Water and Sediment II", which opened in December 2020, and submissions are open until end of September 2021. The new Specail Issue will be also open for large spectra of thematic related with geochemistry of water and sediment from different environments, as the first Special Issue on this thematic was. However, we will insist more on using of appropriate and unified terminology, on quality of writing and correctness of language, as well as on suitable use of statistics and graphical presentations, so that we increase the quality of accepted papers even more.

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