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Danube catchment water chemistry monitoring - elemental pattern determination from source to mouth using ICP-MS

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Monitoring the elemental composition of river water is an important tool to determine the chemical status of a river. However, currently many studies are limited to the analysis of heavy metals included in the EU Water Framework Directive Priority Substances List (Cd, Hg, Ni, Pb). Yet, the assessment of further elements (e.g. Ca, Mg, Si) can give additional relevant information for understanding catchment processes such as soil erosion, weathering, hydrological changes or glacial melting. In addition, site specific "elemental pattern" can be used as tracer for ecological studies, like habitat and migration studies of fish or birds. Elemental information is of particular interest complementary to isotopic data where only little variability in the isotopic signatures can be observed.

In this work, we investigated water samples collected from 68 sampling sites along the longitudinal course of the river Danube including the major tributaries during the Joint Danube Survey 3 (JDS3) in 2013. Water samples were obtained as triplicates in the middle of the river and analyzed using Inductively Coupled - Plasma Mass Spectrometry (ICP-MS). Method validation was performed using riverine water (NRC SLRS-5) certified reference material as well as in-house prepared quality control standards.

Due to the diverse geology and changing natural and anthropogenic factors along the longitudinal course of the Danube, pronounced elemental variations among the water samples were documented. For instance, especially some major elements (Ca, K, Mg, Na) together with some minor elements (Si, Sr) are known to reflect in particular regional geological morphologies. In addition, the variation in Si/Ca ratios can be used as an indicator for weathering conditions, especially in the mountainous areas along the Danube. Elevated concentrations of Cd, Cu, Fe, Ni, and Pb downstream of some large cities and industrial areas are signs of significant anthropogenic impact. In combination, the chemical parameters presented not only allow for the evaluation of water quality, but also of the overall eco-geochemical status of the river at the sampling sites and in a broader sense of the entire Danube catchment. Future efforts will focus on the integration of isotopic and elemental information for improving the understanding and management of the Danube catchment.