



## **Discharge-related variation of the chemical composition of suspended sediment of the River Rhine in the Netherlands**

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The response of the chemical composition of suspended sediment to variations in river discharge may reveal the sources of sediment and associated contaminants. In this study, we used the Waterbase database of Rijkswaterstaat (Dutch Ministry of Infrastructure and Water Management) to examine the relation between the concentration of 53 elements in suspended sediment and discharge of the River Rhine at the Lobith monitoring station near to the German-Dutch border in the period 2011-2016.

The elements Ag, Ar, Ba, Cd, Cr, Cu, Mo, Na, P, Pb, Sb, Sn, Ti, and Zn show a negative power-law relation with discharge. This negative concentration-discharge relation suggests that these elements originate primarily from anthropogenic point source discharges, which are diluted during periods of high discharge. Alternatively, the negative relation with discharge may also indicate that the elements originate from geogenic sources, where the source area shifts to regions with relatively low concentrations during high flows. Furthermore, the residuals of concentration-discharge relations show a seasonality with positive residuals during autumn and winter and negative residuals during spring and summer. This implies that the elements are mainly associated with inorganic sediment particles and that during spring and summer, the element concentrations are diluted by the primary production of organic particulate matter. The elements Ca, Hg, La, Mn, Sr, Te, and W also show a negative power-law relation, but they do not show a seasonality in the residuals. The absence of a seasonality in the residuals may imply that these elements readily adsorb to or associate with particulate organic matter as well as inorganic sediment particles.

The concentrations of Al, Be, Cs, Fe, Ga, K, Li, Mg, Ni, Rb, Th, U, V, and the rare earth elements, except La, show a positive power-law relation with discharge. This suggests that these elements are of geogenic origin, where the soils of the high-flow sediment source areas are characterised by relatively high concentrations of these elements. The concentrations of Co, Nb, Ge, Sm, Tl, and Zr do not show a relation with discharge. The elements that are not or positively related to discharge are negatively correlated with organic C and the residuals of all discharge-concentration relations show the same seasonality as above. This indicates that these elements are mainly associated with clay minerals.