Hydrogeochemistry of Fe and Mn in small boreal catchments: The role of seasonality, landscape type and scale

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To evaluate spatial and temporal variations of metal concentrations in stream water and their correlation to catchment characteristics, water samples were taken in 15 small (0.07 km^2 to 68 km^2) pristine, boreal streams in northern Sweden. Sample collection was conducted on a monthly basis from January 2004 to December 2004, but during spring flood in April-May samples were collected every second day. Total and dissoved concentrations of all major cations (Ca, K, Mg, Na) and trace elements (Fe, Mn and Ti) were determined, by ICP-OES.

All streams had large seasonal variations of most elements, in particular Fe and Mn. During spring flood, increasing concentrations of Fe and Mn were observed in forested catchments (by a factor of 3 to 18 and 6 to 12, respectively). On the contrary, concentrations decreased (by a factor of 11 and 9, respectively) in catchments dominated by wetlands. Sulfate concentrations correlated negatively (r^2=0.81) with increasing area of wetlands, indicating the importance of sulfate reduction within these areas. Furthermore, seasonal patterns of Fe and Mn were observed to be influenced by hydrological factors, but also by redox reactions within the stream system (Fe and Mn are soluble in reducing environments). The strong positive correlation of Fe with Ti (r^2=0.82) indicates that Ti is related to adsorption to Fe oxides.

Finally, the annual transport of metals in these high latitude areas, where the spring flood is the major hydrological event, is dominated by the particulates as observed by large differences between total and dissolved concentrations of Fe and Mn. This is especially pronounced in the larger, lower altitude streams many of which have silty soils in the near stream zone. The results from this study also show that an increased knowledge of landscape characteristics is of great importance in order to predict the hydrogeochemistry of metals in stream water.