Despite numerous past and on-going studies, the interaction of U and organic matter remains a controversial issue as OM properties such as charge, size and functional groups control uranium complexation in aqueous systems. In this work, a reactive transport tool, iCP [1], is used to reproduce data from the Krycklan Catchment Study (KCS) in northern Sweden [2,3]. This site can be considered as a natural analogue for uranium-organic matter interaction. The modelled hillslope transect includes the riparian zone and contains three hydrochemical domains: peat, organic soil and till. The model couples the complexity of a very dynamic hydrogeological system with a mechanistic description of the main processes controlling biochemical cycling of elements in the boreal landscape.

Hydrogeological 2D model

The 2D hill-slope model simulates unsaturated groundwater flow and solute transport under changing hydraulic properties representing soil freezing/thawing cycles. The effective recharge function for 2012 and 2013 was estimated and the model was calibrated against groundwater heads inferred in 3 wells (S4, S12 and S22).

U-OM bonding

U-OM interaction is modelled by assuming U bonding to both fulvic (FA) and humic acids (HA) in the three model domains. The stability constants for UO2-FA and UO2-HA were taken from [8]. The pH values are controlled by the interplay between weathering processes and organic matter degradation. To properly reproduce the climatic impact in the chemistry of the seasonally saturated area, degradation rates have been corrected by temperature and water saturation [12]. Thus, pH and DOC production are able to reproduce the high seasonality of the site.

Concluding remarks

• The hydrogeological model captures the response of groundwater heads to climatic forcing.
• To account for the winter season correctly become crucial in this environment to a proper modelling of the seasonal variation of groundwater heads.
• The hydrogeochemical model reproduces the spatio-temporal patterns observed on site for pH, DOC and U.
• In agreement with a large number of studies [8], our results show that U(VI)-HA bonds are stronger than FA bonds (80% and 15% for U-FA and U-HA, respectively). This can be explained by the acidic conditions of the system. A large proportion of U (95%) is bounded to organic matter.
• Uranium behavior mimics the seasonal fluctuations observed on site.
• Competition of Al, Fe and U for organic matter complexation was assessed (data not shown). Our results confirm that Al and Fe do not modify U-OM mobility.

References