

Studying rare earth elements binding to natural organic matter

A. OTERO-FARIÑA¹, N. JANOT¹ AND J. E. GROENENBERG²

¹ LIEC: Laboratoire Interdisciplinaire des Environnements Continentaux, UMR 7360 CNRS-Université de Lorraine
15, Avenue du Charmois, F-54500 Vandœuvre-lès-Nancy
– France (a.otero.farina@gmail.com)

² Department of Soil Quality Wageningen University,
Wageningen University and Research, P.O. box 47, 6700
AA Wageningen, the Netherlands
(bertjan.groenenberg@wur.nl)

The biogeochemical cycle of Rare Earth Elements (REEs) is being affected by their increased use in modern technologies an increased concentrations of certain REEs have been measured in natural waters. At present there are no regulatory thresholds for REE concentrations and emissions into the environment and knowledge on their environmental behaviour and effects is limited.

The fate and behaviour of REEs in the environment is largely determined by their binding to reactive components, of which organic matter, metal oxides, and clays are considered important. Humic substances (HS, humic and fulvic acids) are the most reactive fractions of natural organic matter, having a high affinity for metal ions. The use of thermodynamic models which could predict the partitioning and speciation of trace metals in terrestrial and aquatic systems is of key importance. The NICA-Donnan model (NDM) is one of the advanced models for ion binding to HS however, at present there are no NDM parameters for REEs binding to HS except Eu.

Here we studied Nd, Gd and Yb binding to a groundwater FA in a batch titration experiment in the pH range 3-7. Free metal ion concentrations were determined using the Donnan Membrane Technique, being the first time this technique was used for REEs.

Using the experimental data for FA together with published data on REE binding to FA and HA we derived generic ND parameters for all the 14 stable lanthanides.