Mobility and fractionation of REE in seasonally waterlogged forest soils

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We present a study from acidic natural forest soils (Chaux Forest, Eastern France) subjected to seasonal waterlogging, which is a widely known phenomenon in wetland soils. Waterlogging led in the present case to reducing redox conditions, triggering the dissolution of Fe-oxyhydroxides and the release of REE to soil water.

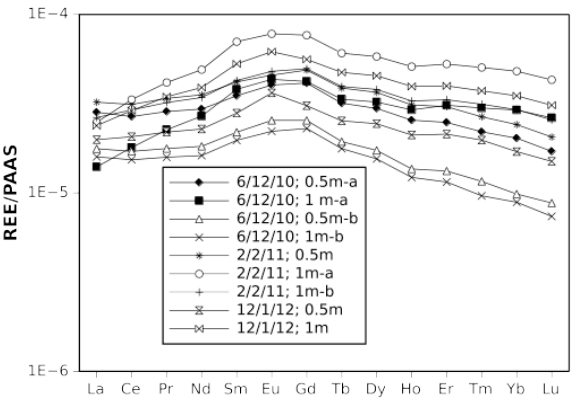

Figure 1: PAAS-normalized REE patterns of soil waters with enrichment of the middle REE and depletion of the HREE.

The soil waters were sampled in piezometer tubes at 0.5 and 1 m depth and at 3 different dates in winter in order to limit the influence of biological activity (December 2010 and 2012, Februrary 2011), and filtered at 0.45 μm. The patterns showed an enrichment of the medium REE (MREE, Eu-Tb) and were depleted in the heavy REE (HREE, Dy-Lu; Figure 1). The degree of MREE-enrichment and HREE-depletion was monitored with Gd/La and La/Yb ratios, respectively. A comparison with the general soil water chemistry showed that these ratios were highly correlated with Al, suggesting that fractionation of the REE patterns was due to a competition with Al. This is in agreement with the study of Marsac et al. 2012 (GCA 89, 1–9) who showed, based on modeling and laboratory experiments, that Al^{3+} competes with the HREE for binding sites on humic acids. Our study is to our knowledge the first one to describe this competition under natural field conditions, and may therefore furnish useful information on the environmental behavior of anthropogenic REE under similar conditions.