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# Controlling the Mobility of Rare Earth Elements (REE) in the environment by organo-mineral Colloids: Insights from pH-Dependent sorption Studies

Yasaman Tadayon<sup>\*1</sup>, Mélanie Davranche<sup>1</sup>, Julien Gigault<sup>2</sup>, Delphine Vatelon<sup>3</sup>, and Aline Dia<sup>1</sup>

<sup>1</sup>Géosciences Rennes – Université de Rennes, Institut National des Sciences de l'Univers, Observatoire des Sciences de l'Univers de Rennes, Centre National de la Recherche Scientifique – France

<sup>2</sup>Takuvik International Research Laboratory – Canada

<sup>3</sup>Synchrotron SOLEIL – Centre National de la Recherche Scientifique, Centre National de la Recherche Scientifique : UR1 – France

## Résumé

Production of high technology products consumes large quantities of rare earth elements (REE), driving up demand and their spread. As a result, concerns have been raised regarding the environmental impact of REE. The dissemination of REE in the environment is controlled by transfer mechanisms depending on environmental physicochemical-parameters and REE speciation. This speciation is predominantly controlled by their binding to solid surfaces, particularly colloids. Colloids composed of organic matter (OM) and iron (Fe) have garnered interest due to their ubiquity and increasing abundance in natural waters as a response to global climate change. The reactivity of these colloids is governed by their structural organization and the availability of surface sites.

In this study, we aim to investigate the influence of pH on the binding of REE to these colloids and their subsequent mobility in the environment. Iron-OM colloids were synthesized through OM titration with Fe(II) solution at pH 6.5. Adsorption experiments of REE (La to Lu) by the colloids were performed at pH 6 and 4, with an ionic strength of 0.05 mol L<sup>-1</sup> (NaCl) and a range of REE/Fe molar ratios (0.0008 to 0.1).

The results revealed that REE primarily bind to the OM component of the Fe-OM colloids, and their mobility is controlled by the response of OM to pH conditions. At pH 6, the solubilization of small organic molecules with increasing REE loading no longer solely controls REE mobility, but the strong solubilization of these small organic molecules becomes a contributing factor. In contrast, at pH 4, the Fe-OM colloids bound a lower amount of REE (4.4 mg g<sup>-1</sup> compared to 12 mg g<sup>-1</sup> at pH 6) but exhibited aggregation. While a major portion of REE remains soluble in solution, those bound to Fe-OM colloids are expected to be immobilized through colloid settlement or trapped within the porosity of soil and sediment. This study provides insights into the complex interactions between REE and Fe-OM colloids and highlights the importance of pH conditions and colloids occurrence in influencing REE mobility and distribution in the environment.

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<sup>\*</sup>Intervenant

**Mots-Clés:** Rare earth elements, Organo, mineral Colloid, Colloidal structure, Adsorption, pH dependency