Hydrodynamic radii of europium(III)–humic substance complexes

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Humic substances (HS) are one of the main component of aquatic and soil systems and are known to play an important role in the transport and binding of metal trace elements such as lanthanides, Ln(III) [1]. Because of their strong interactions with surfaces [2] and their colloidal properties [3], HS may affect Ln(III) geochemistry in water, soils and sediments. Eu(III) speciation is studied in presence of Suwannee river fulvic acid (SRFA), considered as a proxy of natural organic matter reactivity. Complexation of Eu(III) by SRFA in the pH range from 4 to 7 and ionic strength from 0.02 to 0.5 M is studied using time-resolved luminescence spectroscopy and is described with the NICA Donnan model [4]. Besides the description of the complexation, we highlighted inter-particulate repulsions between fulvic acid particles that are complexing Eu(III) at high $C_{SRFA} > 100$; 30 and 10 mg_{SRFA}/L respectively at pH 4, 6, and 7. Such interactions are not yet accounted within the different complexation models [4] [5]. The account of a Donnan volume depending on the hydrodynamic radius of SRFA was proposed by Saito et al. [6]. In this study we propose to characterize the size of Eu(III)-SRFA complexes by Taylor dispersion analysis (TDA) using a capillary electrophoresis instrument [7]. TDA allows measuring Eu-SRFA complexes diffusion coefficients and calculating hydrodynamic radii (R_H). The experiments show that R_H are about 0.9 nm and decrease with C_{Eu} when $C_{SRFA} <$ 100 mg_{SRFA}/L. The R_H are constant at higher C_{SRFA} regardless of pH and C_{Eu} values.

[1] McCarthy *et al.* (1998) *J. Contamin. Hydrol.* **30**, 49-77. [2] Janot *et al.* (2013) *Geochim. Cosmochim. Acta* **123**, 35-54. [3] Jones & Bryan (1998) *Adv. Colloid Interface Sci.*, **78**, 1-48. [4] Kinniburgh *et al.* (1999) *Colloids Surf.* A **151** 147-166. [5] Tipping (1998) *Aquat. Geochem.* **4**, 3–48. [6] Saito *et al.* (2009) *Colloids Surf.* A **347**, 27-32. [7] d'Orlyé & Reiller (2012) *J. Colloid Interface Sci.* **368**, 231-240.