

# Interpretation of REE patterns in natural water based on the stability constants

Y. YAMAMOTO<sup>1</sup> Y. TAKAHASHI<sup>1</sup> AND H. SHIMIZU<sup>1</sup>

<sup>1</sup>Department of Earth and Planetary Systems Science,  
Hiroshima University; yyamamo@hiroshima-u.ac.jp;  
ytakaha@hiroshima-u.ac.jp;  
shimizu@geol.sci.hiroshima-u.ac.jp

Conditional stability constants ( $\beta_M$ ) of all rare earth elements (REE) with fulvic and humic acids were determined using solvent extraction method coupled with inductively coupled plasma mass spectrometry (ICP-MS), except for Ce and Pm. The standard Suwannee River fulvic and humic acids (SRFA and SRHA) received from International Humic Substance Society (IHSS) were employed. REE patterns of the  $\beta_M$  of fulvate and humate were similar to that of acetate at lower pH and larger REE loading level. At higher pH and smaller REE loading level, these patterns become similar to that of bidentate carboxylate like malonate. It is suggested that these binding sites are responsible for the complexation of REE with HS, since the binding sites can be estimated from REE pattern of the  $\beta_M$  of REE-HS complexes as a "spectrum". On the other hand, the  $\beta_M$  of REE-HS complexes can be used for the modeling of REE behavior in natural water. REE pattern of the partitioning ratio between dissolved complexes and surface complexes adsorbed on particulate matters depends on a pair of the  $\beta_M$  of main ligands in each phase. These patterns in seawater can be explained by the equilibrium between dissolved carbonate complexes and surface complexes adsorbed on the mixture of Fe-Mn hydroxides and HS. Our results enable us to estimate REE species in natural water in details through the interpretation of natural REE patterns based on the  $\beta_M$  of all REE with HS.

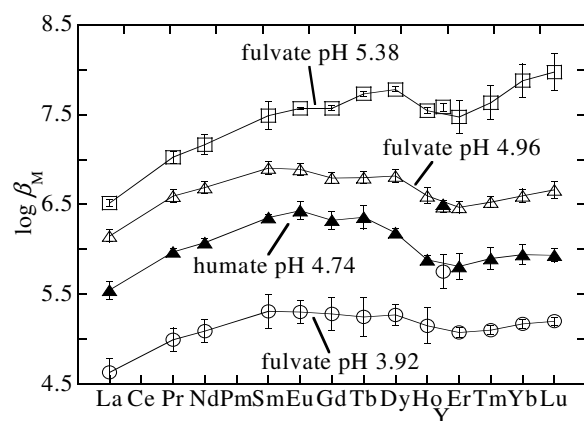


Figure 1. REE patterns of the  $\beta_M$  of REE with HS at various pH and larger REE loading level. Ionic strength was adjusted at 0.10 M by NaClO<sub>4</sub>.