

## Development of a Thermodynamic Database for Europium

N. JORDAN<sup>1,\*</sup>, N. HUITTINEN<sup>1</sup>, H. LÖSCH<sup>1</sup>,  
A. BARKLEIT<sup>1</sup>, F. BOK<sup>1</sup>, A. HELLER<sup>2</sup>,  
V. BRENDLER<sup>1</sup>

<sup>1</sup>Helmholtz-Zentrum Dresden-Rossendorf, Institute of Resource Ecology, Bautzner Landstrasse 400, 01328 Dresden, Germany

<sup>2</sup>Technische Universität Dresden, Institute of Zoology, 01069 Dresden, Germany

(\*correspondence: [n.jordan@hzdr.de](mailto:n.jordan@hzdr.de))

Due to their wide-spread application of Rare Earth Elements (REE) in high technological products, their separation from one another is mandatory. The optimization of physico-chemical conditions for the design of any effective extraction and recycling processes relies on accurate, consolidated, internationally recognized and reliable thermodynamic data, which are so far not available for REE.

This study aims at providing such a critically-assessed and internally consistent data base for europium. An evaluation of all available primary literature sources for Eu(III) complexation constants ( $\log \beta$ ) and solubility products ( $\log K_{sp}$ ) with inorganic ligands ( $\text{OH}^-$ ,  $\text{Cl}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$ , and  $\text{CO}_3^{2-}$ ), evidenced several critical issues i) inconsistencies between different sources, ii) lack of accurate activity coefficient treatment in case of the formation of weak complexes, and iii) absence of independent spectroscopic validation of the stoichiometry of the proposed complexes.

Thus, several actions have been undertaken:

- a) recalculation of the  $\log \beta$  of weak complexes ( $\text{Cl}^-$ ,  $\text{NO}_3^-$ ) by using an hypothetical reference state (at trace ligand concentration) [1].
- b) in case of  $\text{PO}_4^{3-}$  complexation, Time-resolved Laser-induced Fluorescence Spectroscopy was used to monitor the speciation evolution of Eu at micromolar concentrations and to identify the prevailing species as well as their stoichiometries. The respective complexation constants were derived from the spectroscopic data sets.
- c) the conditional  $\log \beta$  and  $\log K_{sp}$  were extrapolated to standard conditions ( $I = 0 \text{ M}$ ,  $T = 298.15 \text{ K}$ ) using the Specific Ion Interaction Theory.

[1] Spahiu, K. et al. (1998) Radiochim. Acta 82, 413-419.