Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.9780

A critical review of the solution chemistry, solubility, and thermodynamics of Eu(III)

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New materials showing specific magnetic and/or electrooptic properties incorporate critical raw materials such as Rare Earth Elements (REE). Due to their very specific technological application, it is necessary to separate the REE from each other and enrich them. The optimization of physico-chemical conditions for the design of effective extraction and recycling processes of REE relies on accurate and reliable thermodynamic data. However, no consolidated and internationally recognized Thermodynamic Database (TDB) is currently available for REE.

Several reviews and reports [1-5] on the aqueous chemistry/geochemistry of europium were published, but had several drawbacks, for example:

→ insufficient transparency about the selection procedure,

→ lack of systematic screening to gather primary literature sources,

→ too high reliance on the analogy with trivalent actinides,

→ for weak complexes such as chloride and nitrate, changes in the activity coefficients due to the replacement of up to 100 % of the background electrolyte anion by Cl^- or NO_3^- was either completely overlooked or, if recognized, not handled properly,

→ too high reliance on the charge analogy for the estimation of missing ion interaction coefficients when the Specific ion Interaction theory (SIT) was applied.

This study aims at significantly improving the situation by carefully addressing all aforementioned issues in order to provide a reliable, robust, and internally consistent TDB for europium. All available primary literature sources for Eu(III) complexation constants and solubility products for the OH^-, Cl^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, and CO_3^{2-} inorganic ligands were thoroughly evaluated. This allowed deriving a recommended set of thermodynamic data at infinite dilution and 25 °C using the SIT. Results concerning the chloride, sulfate, and phosphate ligands will be presented [6].

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