

UV-Vis spectrophotometric determination of the hydrolysis constants of erbium at near-neutral to alkaline pH and 25 °C

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The rare earth elements (REE) have important applications in the high-tech and green technology industries because of their electronic, magnetic, optical and catalytic properties [1]. While it is difficult to chemically separate these elements, geologic systems indicate that the REE can be fractionated, mobilized, and enriched from fluid-rock interaction [2-4].

The role of aqueous speciation on the behavior of REE at acidic pH has been investigated for chloride, fluoride, and sulfate complexes [4]. In contrast, geochemical modeling of the behavior of REE at near-neutral to alkaline pH indicates that the REE hydroxyl complexes may dominate [3]. However, our current models for the hydroxyl complexes mostly rely on the theoretical data derived by Haas et al. [5]. We therefore present new UV-Vis spectrophotometric experiments on the hydrolysis of the heavy REE, erbium (Er), at a reference temperature. Surprisingly, only a few experimental data are currently available for the Er hydroxyl complexes [6-7].

The spectrophotometric experiments were conducted at pH between 7.0 and 9.0 using m-cresol purple as pH indicator at 25 °C. The experiments indicate that with increased dissolved ErCl_3 concentrations, the hydrolysis of Er^{3+} results in an increase in proton (H^+) activity which was traced by the absorbance of the pH indicator at 434 nm and 578 nm. This allowed determining the hydrolysis constants of $\text{Er}(\text{OH})^{2+}$, $\text{Er}(\text{OH})_2^+$, $\text{Er}(\text{OH})_3^0$, and $\text{Er}(\text{OH})_4^-$. The measured pH and stability constants derived from UV-Vis spectrophotometry were further evaluated using the GEMSFITS optimization program [8] and compared to previously reported experimental results. This new combined approach is promising and will be used as a starting point to determine the hydrolysis constants of other REE at hydrothermal conditions.

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