An experimental study of the REEs solubilities in carbonate-bearing aqueous solutions under hydrothermal conditions

M. KOKH[1-3], L. TRUCHE[1], B. LUAIS[2,3], M.C. BOIRON[3], C. PEIFFERT[3], A. SCHUMACHER[2,3] AND A.Y. BYCHKOV[4]

[1] ISTerre, Université Grenoble Alpes Saint Martin d'Hères, France (maria.kokh@univ-grenoble-alpes.fr)
[2] CRPG-CNRS, UMR7358, Université de Lorraine, Vandœuvre-lès-Nancy, France
[3] Université de Lorraine, CNRS, GeoRessources, F-54000 Nancy, France
[4] Lomonosov Moscow State University, Russia

Aqueous carbonate complexes of the Rare Earth Elements (REEs) are known to be among the most stable species at ambient temperature [1]. Our current knowledge of the REEs solubilities in hydrothermal carbonate-rich solutions relies entirely on the theoretical predictions [2, 3], that are used up to present for the thermodynamic modelling [4, 5]. New experimental data are required to evaluate the role of carbonate complexes in hydrothermal transport of the REEs.

Here, we conducted autoclave experiments to measure the solubility of the REEs oxides, in CO_2 and carbonate-bearing aqueous solutions across a wide range of acidity, at temperatures from 100 to 250 °C and at saturated vapor pressure of the system. The solid phases were recovered after experiments and studied with XRD analyses, that revealed the formation of the REE hydroxides and carbonates. The REEs in sampled solutions were first isolated from the concentrated saline matrix (Na_2CO_3, $NaHCO_3$) using ion-exchange resin, before being measured by ICP-MS. The obtained results were confirmed with the direct LA-ICPMS measurements of REEs in the experimental solutions loaded in glass capillaries. Our results show that at neutral-to-alkaline conditions the heavy REEs are generally more soluble than the light REEs. The retrograde behavior of the REEs solubilities was enhanced by the precipitation of sodium carbonate at 250°C. Work is in progress to give a thermodynamic interpretation of the obtained results.

Acknowledgments to the French National Research Agency through the "Investissements d'avenir" national research program (ANR-10-LABX-21–LABEX RESSOURCES21)

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