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Characterization of La-Complexes in Carbonate-Bearing Fluids from 100-600°C

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Rare earth elements are pervasive in green energy technologies and economically enriched deposits are frequently associated with transport by hydrothermal fluids. In the last decade, a multitude of studies have been carried out to investigate the solubility and speciation of these elements at hydrothermal conditions. However, the very limited information available for REE behavior in carbonate-bearing hydrothermal fluids is a major gap that hinders our ability to predict the mobility of REE in natural systems.

In this study, we determine the speciation of La in carbonate-bearing fluids at elevated temperature (100-600°C) by the autoclave solubility technique and by cold-seal solubility technique using synthesized La-monazite as the reference phase. The phase purity was confirmed by Raman spectroscopy and X-ray diffraction before and after solubility experiments. It was found that La-carbonate complexes overwhelmingly predominate in aqueous solutions at all conditions investigated. Additionally, preliminary thermodynamic parameters for these identified aqueous complexes have been derived and suggest that the speciation of La in alkaline solutions is controlled by multiple factors: namely temperature, carbonate concentration, and pH.