Review of: "Carbonate complexation enhances hydrothermal transport of rare earth elements in alkaline fluids"

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Potential competing interests: The author(s) declared that no potential competing interests exist.

This study provides a direct evidence that the formation of hydroxyl-carbonate complexes in alkaline fluids enhances hydrothermal mobilization of light rare-earth elements (LREE) at T ≥ 400 °C and high rare-earth elements (HREE) at T ≤ 200 °C. The study revealed differences in REE transport modes in alkaline and acidic fluids and demonstrated that alkaline fluids appear to be key to the mineralization of REE hydrothermal fluorocarbons in carbonatitic systems.

Tool:

The use of a high-temperature in situ XAS, that consists in a dedicated autoclave equipped with X-ray transparent highpressure windows to evaluate the hydrothermal behavior of La^{3+}, Sm^{3+}, Gd^{3+}, Er^{3+}, Yb^{3+}, and Y^{3+} in alkaline solutions. Despite the use of a special system, only the solubility trend of Yb^{3+} was obtained experimentally. For La^{3+}, Sm^{3+}, Gd^{3+}, Er^{3+}, and Y^{3+}, an “apparent” solubility trend was obtained.

The present study brought some novelties, among which stand out:

1. Combined solubility and speciation work suggested that hydroxyl-carbonate complexes promote REE transport in alkaline fluids.
2. Transport of HREE in alkaline fluids is limited above 300°C.
3. Transport of LREE in alkaline fluids is favored under high temperature conditions.
4. Under acidic conditions, the addition of fluor ions favors the precipitation of REE. Under basic conditions, fluor ions increase the solubility of REE complexes by combining with hydroxyl-carbonate or carbonate ions.

Conclusions

1. This study confirmed that carbonate-rich fluids can transport significant amounts of REE under typical hydrothermal conditions even in the presence of fluorides.
2. This fact is enriching for the interpretation of hydrothermal mineralization associated with carbonatite-associated rare-earth-element (REE) deposits.
3. Even RD&I can be developed for the fractional separation of LREE and HREE from the results shown in this article.