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Integrating EPMA and LA-ICP-MS to comprehend mineralogical and textural controls on REY enrichment in Mediterranean and Caribbean karst bauxites

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Karst bauxites are emerging as important unconventional sources of rare earth elements and yttrium (REY), yet the mechanisms controlling their enrichment vary widely between geological provinces. A combined analytical strategy using electron probe microanalysis (EPMA) and laser ablation ICP-MS (LA-ICP-MS) was applied to bauxites from the Mediterranean (Iberian Peninsula) and the Caribbean (Sierra de Bahoruco, Dominican Republic) to clarify how mineralogy and textures influence REY distributions.

Mediterranean bauxites show moderate REY contents, typically in the order of a few hundred ppms, with a median value of 341 ppm. Caribbean bauxites, in contrast, display higher and more variable REY contents, with a median value of 1838 ppm. The REY-bearing minerals are mostly Al-oxyhydroxides, onto which REY are most likely adsorbed, and phosphates (e.g., monazite, xenotime) and carbonates (e.g., bastnäsite-group) [1 and references therein].

EPMA provided detailed information on major-element compositions, allowing clear differentiation between the kaolinite-rich Mediterranean bauxites and gibbsite-dominated Caribbean bauxites. This mineralogical framework guided the placement of LA-ICP-MS spots, enabling targeted, high-resolution trace-element analyses across specific domains that EPMA alone cannot quantify. The integration of both techniques allowed direct comparison of domains hosting REY. Preliminary results indicate that Caribbean Al-oxyhydroxides and Fe-oxyhydroxides have high, yet variable, REY contents (median of 2721 ppm), whereas Mediterranean counterparts present more moderate REY values of few hundred ppm (median of 329 ppm).

The combined EPMA–LA-ICP-MS workflow reveals the mineralogical and textural controls that govern REY enrichment in karst bauxites and provides a high resolution and quantitative analysis of trace elements. This integrated approach provides a robust foundation for evaluating the metallogenic potential of karst bauxites and identifying REY-hosting domains relevant to resource assessment.

References:

[1]: Domínguez-Carretero, D., Aiglsperger, T., Villanova-de-Benavent, C., Torró, L., Pujol-Solà, N., Llovet, X., Bover-Arnal, T., Tisora, À., Domènech, C., Ramírez, A., Rodríguez, J., Dold, B., Proenza, J.A., 2026. Rare Earth Element and Yttrium (REY) Hyper-Enriched Karst Bauxites of the Mercedes-Aceitillar Mining District, Sierra de Bahoruco, SW Dominican Republic. Economic Geology, accepted. https://doi.org/10.5382/econgeo.5214