# Geochemical patterns in karst bauxite of the Unterlaussa mining district (Upper Austria)

**F.J. Hampl[1], F. Melcher[1], I. Dunkl[2], B. Schmidt[3], V. Bertrandsson Erlandsson[1]**

*[1]Chair of Geology and Economic Geology, Montanuniversität Leoben, Peter-Tunner-Straße 5, 8700 Leoben, Austria*
*[2]Department of Sedimentology & Environmental Geology, Geoscience Center, Georg-August-Universität Göttingen, Goldschmidtstraße 3, 37077 Göttingen, Germany*
*[3]Department of Mineralogy, Geoscience Center, Georg-August-Universität Göttingen, Goldschmidtstraße 1, 37077 Göttingen, Germany*
*e-mail: ferdinand.j.hampl@gmx.at*

Numerous studies demonstrated the great potential of karst bauxites as sources of critical metals. The European karst bauxites may thus help to gain more independence from questionable non-European metal suppliers. Yet several European karst bauxites are untouched by modern scientific methods and the processes that are responsible for their element enrichment and depletion patterns are not fully understood. However, understanding the geochemical patterns in karst bauxites is not only fundamental for a prudent economic usage but can also facilitate reconstructions of paleo-environments and redox processes during weathering and diagenesis. To better understand the geochemical patterns, we investigated three profiles of Upper Cretaceous karst bauxite in the Unterlaussa mining district (Upper Austria) and used geochemical and mineralogical methods such as (micro-) X-ray fluorescence, (laser ablation-) inductively coupled plasma mass spectrometry, scanning electron microscopy, electron microprobe mapping and X-ray diffraction.

According to our results, the boehmitic karst bauxite was formed by intense weathering of a polygenetic sediment (parent material) that was deposited on karstified dolostone (Hampl & Melcher, 2023). The presence of detrital chromite in the karst bauxite suggests that sediments formed by weathering of ophiolitic material in the hinterland of the depositional site were also part of the parent material. (Sub)tropical weathering of the composite parent material caused the dissolution of aluminosilicates and the enrichment of weathering-resistant minerals. These weathering processes not only led to chemical depletion and enrichment patterns that are typical for karst bauxites (e.g., pronounced $Al_2O_3$, $Fe_2O_3$ and $TiO_2$ enrichment, and $SiO_2$, alkali and alkaline earth metal depletion) but also resulted in substantial enrichment of several critical metals compared to the upper continental crust: e.g., rare earth elements (REEs; La-Lu + Sc, Y) up to 2277 ppm, Li up to 900 ppm, or V up to 916 ppm. Most of the REEs and Li are enriched in the lowermost part of the bauxite and clay minerals are the most likely hosts. Moreover, the element distribution patterns also indicate reducing conditions in the lower part and redeposition in the upper part of the bauxite. Even though Cr- and U-mobility normally only plays a subordinate role in karst bauxites, we found a macroscopic, authigenic chromium oxyhydroxide mineralization and discrete U-minerals in reduction spheroids. Aside from U, some of these reduction spheroids are extremely rich in redox-sensitive elements such as V, Cr, or Mn. We discuss possible formation models for this unique U-mineralization.

Our results highlight the economic potential and the ample information content of karst bauxites and call for more European initiative to investigate them.

Hampl FJ, Melcher F (2023): The formation of the Unterlaussa karst bauxite (Austria) – A re-evaluation of the established model. - J Geochem Explor 245, 107141. https://doi.org/10.1016/j.gexplo.2022.107141