

***In situ* techniques to investigate the dynamics of mineral interfaces dissolving under laboratory and field conditions**

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Rock weathering is a key process in geosciences, which transfers elements from rock-forming minerals to environmental fluids. These elements can constitute nutrients, metal contaminants, or building blocks for secondary minerals such as clays. On the other hand, weathering also leaves an imprint on mineral surfaces, which can undergo dramatic changes in terms of roughness or composition for instance. These changes include the formation of etch pits, surface altered layers, or other surface features. While fluid-rock interactions have mostly been investigated through the lens of fluid chemistry, recent years have seen a growing interest in understanding the evolution of mineral surfaces associated with (bio)weathering processes, either to unravel fundamental mechanisms underpinning mineral dissolution, or for the use of mineral surfaces as probes of fluid-mineral interactions in complex environments such as soils. Gaining further fundamental understanding of the dynamics of fluid/mineral interactions will partly depend on our ability to probe the *in situ* evolution of mineral surfaces through time with appropriate frequency, precision and statistics.

We developed an array of fluid cells and environmental chambers to capture the evolution of the microtopography of mineral interfaces *in situ*, in the course of their dissolution, using interferometry techniques. These experimental setups were designed to meet the requirements of microbial culture or the use of corrosive fluids in order to enable a wide range of field-relevant conditions. We used these setups to unravel the dynamics of well-calibrated calcite surfaces exposed to heterogeneous or variable fluid conditions, which despite their environmental relevance cannot be probed with conventional approaches based on fluid data. Overall, these new experimental capabilities will shed new light on the dynamics of fluid-mineral interactions over a broad range of topics in Earth and environmental sciences.