

Probing mineral reactivity with vertical scanning interferometry: Andreas Lüttge's legacy and beyond

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The quantitative description of crystal dissolution kinetics is an area of research that can hardly be dissociated from the theoretical and experimental contributions of Andreas Lüttge. In the late 90s, while most studies at the time were aimed at deriving so-called 'kinetic rate laws' based on powder dissolution experiments, Lüttge and co-workers introduced a radically different approach to investigate mineral reactivity, relying on the monitoring of mineral surface topography at the sub-micron scale [1]. This strategy has contributed to shape our current understanding of mineral reactivity, from the early development of the stepwave model [2] supported by stochastic dissolution simulations [3], to the demonstration of the intrinsic variability of mineral reactivity [4] and the discovery of the pulsating nature of crystal dissolution [5]. A key aspect of this methodological shift is that mineral reactivity could remain accessible even under conditions where the fluid chemistry is no longer informative and/or available. In this presentation, I will show how we applied and extended this approach to gain further insight into mineral reactivity. Such developments include measurements of (i) dissolution anisotropy [6-8], (ii) mineral dissolution kinetics at close-to-equilibrium conditions [8, 9], (iii) mineral weathering rates in the environment [10], (iv) traces of microbial contribution to mineral alteration [11, 12], partly revealed through the statistical characterization of mineral dissolution *in-situ*, thanks to the development of a homemade fluid-cell coupled to vertical scanning interferometry. Altogether, these studies have contributed to broaden the spectrum of conditions under which mineral reactivity can be measured, which would have likely never emerged without the pioneering momentum initiated by Andreas Lüttge and his group.

[1] Lüttge et al. *Am. J. Sci.* (1999)

[2] Lasaga, Lüttge. *Science* (2001)

[3] Kurganskaya et al. *GCA* (2012)

[4] Fischer et al. *GCA* (2012)

[5] Fischer, Lüttge. *PNAS* (2018)

[6] Daval et al. *GCA* (2013)

[7] Bouissonnié et al. *J. Phys. Chem. C* (2020)

[8] Pollet-Villard et al. *GCA* (2016)

[9] Bouissonnié et al. *Chem. Geol.* (2018)

[10] Wild et al. *GCA* (2019)

[11] Wild et al. *Geology* (2021)

[12] Stigliano et al. *Astrobiology* (in press)