Atomic Force Microscopy at Mineral-Water Interfaces: From High-Resolution Imaging to Chemical Identification

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For understanding, modelling and predicting processes at the mineral-water interface, the atomic force microscope (AFM) constitutes an invaluable tool. *H*igh-resolution imaging of interfacial structures reveals molecular-scale insights into, *e.g.*, surface dissolution, restructuring and growth in the absence and presence of additive molecules. From three-dimensional force data, information on the hydration structure at an interface can be obtained.

Here, recent advances in the AFM instrumentation will be presented [1, 2] that allow for atomic-resolution imaging of mineral-water interfaces as well as hydration layer mapping. With these modifications, AFM sheds light onto, *e.g.*, pH-induced chages in the adsorption structure of Alizarin Red S on calcite (10.4) [3], the calcite surface restructuring induced by Congo Red [4] and Eriochrome Black molecules [5]. Three-dimensional mapping allows for resolving the hydration structure above mineral surfaces and even enables chemical identification of interfacial cations [6].

[1] Adam *et al.* (2014) *Rev. Sci. Instrum*. **85** 023703. [2] Söngen *et al.* (2016) *Rev. Sci. Instrum*. **87** 063704. [3] Schreiber *et al.* (2013) *Soft Matter* **9** 7145-7149. [4] Momper *et al.* (2015) *Langmuir* **31** 7283-7287. [5] Nalbach *et al.* (2016) *Langmuir* **32** 9975-9981. [6] Söngen *et al.* (2017) *Langmuir* **33** 125-129.