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Chlorite topography and dissolution of the interlayer studied with atomic force microscopy

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Abstract

The weathering of rocks is a process important for the understanding of soil formation as well as a general understanding of the interaction between litho- and hydrosphere. Phyllosilicates in general are of special importance for the understanding of weathering processes due to their abundance in rocks and soils. A common phyllosilicate in soils is chlorite, which has a structure composed of a combination of two distinct layers, the tetrahedral-octahedral-tetrahedral (TOT) and the interlayer (i.e., the octahedral layer between TOT layers). In this study, the morphology and dissolution of chlorite in pure water has been visualized using atomic force microscopy. Upon cleavage, the TOT layer shows atomically flat terraces and steps, while the interlayer presents strips and voids. In pure water, dissolution channels and equilateral, mono-oriented triangular etch pits form in the interlayer and lead to progressively increased solubilization. Dissolution channels are proposed to originate from structural defects, while a conceptual model is discussed to explain the presence of triangular etch pits. In this model, their formation is driven by the different reactivity of the two octahedral configurations along the etch pits. It is not currently known which of these is the most stable configuration, however we propose arguments that point toward a specific orientation. The conceptual model is supported by experimental data and is potentially applicable to all mineral structures constituted by continuous octahedral layers.

Keywords: Chlorite, atomic force microscopy, etch pits, brucite-like