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In-situ measurement of dissolution of anorthite in Na-Cl-OH solutions at 22 °C using phase-shift interferometry

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Abstract

In-situ measurements of anorthite dissolution in Na-Cl-OH solutions at an ionic strength (IS) of 0.5 mol/L (*M*) and in artificial seawater (IS = 0.7 *M*) were conducted at 22 °C using white-light, phase-shift interference microscopy (PSI-M). Nanometer-scale surface topography by PSI-M revealed three-dimensionally inhomogeneous surface dissolution, which is commonly observed as retreating steps on anorthite surfaces. Continuous dissolution of the anorthite cleavage surface (010) was successfully measured within a day. The vertical dissolution velocity was 4.3×10^{-5} to 1.4×10^{-3} nm/s. The obtained dissolution rates showed a typical dependency on pH with a reaction order of 0.191, and could be consistently extended to the previous data obtained under acidic conditions (Luttge et al. 1999). In-homogeneities in the vertical dissolution velocities at each pH condition could be interpreted by the step dynamics explained by the Burton-Cablera-Frank (BCF) theory (Burton et al. 1951). These results emphasize that the velocity of step retreat is a strong function of the step density, which has to be taken into account when describing the global dissolution phenomena on mineral surfaces.

Keywords: Interferometry, dissolution, anorthite, step dynamics