Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35533

Mineral dissolution by dimeric complexes

XIAOXU LI[1], QING GUO[2], YATONG ZHAO[1,3], CHANG QIAN[4], MAXIME POUVREAU[1], TRENT GRAHAM[5], PING CHEN[1], CHANG LIU[4], BENJAMIN A LEGG[1], QIAN CHEN[4], AIJUN MIAO[3], ZHEMING WANG[1], JAMES J. DE YOREO[6], CAROLYN I. PEARCE[1], AURORA E. CLARK[2], KEVIN M. ROSSO[7] AND XIN ZHANG[1]

[1]Pacific Northwest National Laboratory
[2]University of Utah
[3]Nanjing University
[4]University of Illinois at Urbana-Champaign
[5]Pacific Northwest National Lab
[6]University of Washington
[7]Pacific Northwest National Laboratory (PNNL)

Mineral dissolution is typically thought to occur by the detachment of monomeric building blocks of the crystal structure, even though it is now well-known that mineral growth can occur through the attachment of polynuclear clusters. Using in situ high-speed atomic force microscopy to examine step-edge retreat dynamics at high resolution, we report that the dissolution of gibbsite in alkaline solutions occurs by the release of aluminate dimers, which subsequently dissociate into the monomeric species that dominate the solution. The observed dissolution anisotropy is readily explained by this mechanism, which was further supported by density functional tight-binding simulations of detachment activation energies. Recognition that such polynuclear dissolution mechanisms exist may enable an improved understanding of processes regulating mineral dissolution rates in nature and industry.