# Albite dissolution kinetics: is it the pits?

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Currently, there is a large database of feldspar dissolution rates measured far from equilibrium over a range of pH and temperature. In order to understand mineral weathering in nature, it is essential for us to investigate the dissolution mechanisms that govern weathering for near-equilibrium environments. A predictive tool in the form of a fundamental rate law for mineral dissolution based on crystal structure is now available (Lasaga and Luttge, 2001, 2002). Determining the ΔG dependence of dissolution rates is important for testing the validity of this rate law, which predicts non-linear, non-TST behavior as equilibrium is approached. A key observation, based upon Monte Carlo simulations (Blum and Lasaga, 1987), predicts the opening of etch pits and a corresponding increase in dissolution rates. Etch pits have been observed on feldspar grains as small as 50 µm (e.g. Knauss and Wolery, 1986). Can we say with certainty that this process holds true for all grain sizes? Is there a grain size below which this mechanism no longer applies?

Historically, dissolution rates have been measured indirectly using powdered materials. Rates from albite powders (pH 9, 80°C, Burch et al., 1993) correspond to a surface normal retreat velocity of $33.2 \times 10^{-7}$ nm/sec. In vertical scanning interferometry, this rate is quantified by *direct* observation of the mineral surface. In our single crystal experiments under otherwise identical conditions, this velocity demands an overall change in surface height of 7.5 nm after 624 hours, if distributed homogeneously. In contrast, if removal occurred at etch pits, these would be well within the range of the interferometer's resolution. We see no evidence of *any* dissolution despite our (sub)nanometer detection limit. These data indicate that the critical ΔG necessary for etch pit opening (Blum and Lasaga, 1987) was not achieved. Consistent with our observations, we would not expect rapid dissolution without the presence of etch pits as a source of dissolution "stepwaves" (Lasaga and Luttge, 2001). Our data, in comparison to Burch et al. (1993), imply that as grain size decreases, dissolution at the edges of grains may become the dominant source for stepwaves, eliminating the need for etch pits to initiate rapid dissolution.

## References

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# Light Driven Environmental Genomics

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Environmental genomics or Ecogenomics is a new emerging field that enables us to look at parts of the ocean that were, until recently, masked to us. With present estimates suggesting that >99% of the microorganisms in most environments are not amenable to growth in pure culture, thus very little is known about their physiology and roles in the ocean. These organisms can, however, be categorized into phylotypes according to their ribosomal RNA (rRNA) genes, which can be amplified directly from environmental DNA extracts, cloned, and sequenced. Although this approach has provided information on the identity and distribution of microbial species, rRNA gene sequences alone do not reveal the physiology, biochemistry, or ecological function of uncultivated microorganisms. This problem can be now bypassed by accessing the genomes of these microorganisms and identifying protein coding genes and biochemical pathways that will shed some light on their physiological properties and ecological function.

Recent discoveries using the ecogenomics approach, including the oceanic proteorhodopsin photothropy and the hidden players in aerobic anoxygenic photosynthesis, will be discussed as well as new findings regarding unexpected diversity among oxygenic photosynthetic microorganisms.

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