



SCIENCE @ DIRECT

Register or Login:  Password:  

Home	Search	Journals	Abstract Databases	Books	Reference Works	My Profile	Alerts
------	--------	----------	--------------------	-------	-----------------	------------	--------

Quick Search:  within   **Geochimica et Cosmochimica Acta**

Volume 53, Issue 2, February 1989, Pages 373-382

doi:10.1016/0016-7037(89)90389-X   
Copyright © 1989 Published by Elsevier Science Ltd.This Document  
▶ **Abstract**

Other article

Actions

- [Cited By](#)
- [Save as Citation Alert](#)
- [E-mail Article](#)
- [Export Citation](#)

**Dissolution kinetics of strained calcite**Jacques Schott<sup>1</sup>, Susan Brantley<sup>2</sup>, David Crerar<sup>3</sup>, Christophe Guy<sup>1</sup>, Maria Borcsik<sup>3</sup> and Christian Willaime<sup>4</sup><sup>1</sup> Laboratoire de Géochimie, Université Paul Sabatier, 31062, Toulouse Cedex, France<sup>2</sup> Pennsylvania State University, Department of Geosciences, University Park, PA 16802, U.S.A.<sup>3</sup> Princeton University, Department of Geological and Geophysical Sciences, Princeton, NJ 08544, U.S.A.<sup>4</sup> Institut de Géologie, Université de Rennes, 35042, Rennes Cedex, France

Received 19 April 1988; accepted 2 December 1988. ; Available online 27 March 2003.

**Abstract**

Interface-limited dissolution of minerals occurs non-uniformly with preferential attack at sites of excess surface energy such as dislocations, edges, point defects, microfractures, etc. Strained crystals are predicted to show higher dissolution rates due to the increased internal energy associated with dislocations and due to enhanced nucleation of dissolution pits at dislocation outcrops on the surface. Using calcite strained to different degrees, we have observed a measurable rate enhancement of two to three times relative to unstrained crystals at temperatures from 3 to 80°C. This rate enhancement is large compared to that predicted from the calculated increase in crystal activity due to strain energy, but small compared to the three orders of magnitude difference in dislocation densities for the crystals tested ( $10^6$ – $10^9$  cm<sup>-2</sup>). Measurements over a range of pH (4.5–8.3) and temperature (3–80°C) showed that the rate enhancement increased with increasing pH and decreasing temperature. Calculations based on the excess free energy of screw dislocations suggest that dissolution rate enhancement should become significant above a critical defect density of roughly  $10^7$  cm<sup>-2</sup>, in apparent agreement with our observations.

Crystal dissolution comprises several parallel processes operating in parallel at active sites. The small relative enhancement of dissolution rate with defect density reflects the greater quantity of dissolved material delivered to solution from receding edges and ledges relative to material coming from point defects and dislocations. Our data, coupled with existing information on other minerals, suggest that generally applicable kinetic measurements can be made on low-strain, macroscopic mineral specimens. However, kinetic data on highly strained minerals should include measurement of defect density because of the rate vs. strain correlation. Selective dissolution can be expected to occur in naturally-deformed rocks, where heterogeneity in dislocation distribution could cause solution transfer and deformation.

**Geochimica et Cosmochimica Acta**  
Volume 53, Issue 2, February 1989, Pages 373-382This Document  
▶ **Abstract**