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Etch pit coalescence, surface area, and overall mineral dissolution rates

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ABSTRACT

A simple computer model for the dissolution kinetics of crystalline matter governed by etch-pit formation predicts different development, paths, and states for geometric, total (BET), and reactive surface area during the dissolution process. The model also explores the dynamics of the dissolution rate of a given model crystal surface as a function of the development of surface area. Because the surface area term is used in the normalization of bulk dissolution rates, results of this normalization reflect the large differences explored. Based on this evaluation, we discuss the application of the diversely defined surface area terms. In the light of this discussion, the likelihood of an unambiguous definition or application of reactive surface area is problematic.

The model focuses on the relationship between the variation in total surface area and the global dissolution rate, and thus is independent of specific surface reaction mechanisms. The actual model calculations presented as an example in this paper utilize experimentally determined dissolution data of three dolomite [$CaMg(CO_3)_2$] cleavage surfaces obtained by vertical scanning interferometry (VSI). Similar data from minerals such as calcite, feldspars, and barite can be used and make this model applicable to a range of different crystalline phases.