

Mechanisms and rates of dolomite dissolution from single-crystal surface microscopic analysis

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Recent studies have shown how mineral dissolution rates can be accurately quantified by taking into account the real changes of surface topography and the corresponding heterogeneous distribution of dissolution fluxes [1, 2].

Dolomite dissolution was studied on single mm-sized crystals at 50 °C as a function of pH (3.4<pH<9.0), by analyzing the surface topography evolution during the course of the reaction, using both AFM and VSI techniques, and by measuring the corresponding vertical surface retreat rate on two different surfaces, the (104) natural cleavage plane and a plane cut approximately parallel to the (001) crystallographic orientations. Both polished and unpolished samples were used to test the influence of defects created by polishing of the (104).

Results show that (001) miscut surfaces dissolve between 1.5 and 3 times faster than the (104) cleavage planes in acidic solutions but becomes slower than the (104) plane at basic pH's. Extensive dissolution of the (001) plane brings about the formation of microscopic pyramidal features delimited by (104) microfacets, which is consistent with development of low-energy crystal morphologies but contrasts with the triangular etching observed on calcite miscut surfaces perpendicular to the same axis [3].

No clear difference in reactivity was observed between polished and unpolished sample surfaces under acidic conditions, whereas the presence of surface defects generated by polishing enhanced the dissolution rate of the mineral compared to unpolished, but rougher, surfaces under basic pH. Comparison of rate spectra, obtained by VSI analysis of dolomite unreacted and reacted surfaces, shows a decreased variance and asymmetry of surface energy distributions with increasing pH, which thus characterize slower rates of mineral dissolution. Dolomite cleavage planes exhibit vertical retreat rates that are roughly constant as a function of time.

[1] Fischer et al. (2012) *Geochim. Cosmochim. Acta* **98**, 177–185. [2] Emmanuel (2014) *Chem. Geol.* **363**, 262–269. [3] Smith et al. (2013) **360-361**, 10–21.