

## **Linking calcite surface roughness resulting from dissolution to the saturation state of the bulk solution**

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Characterising the evolution of the surface topography of minerals undergoing dissolution is key for thorough understanding of mineral weathering [1]. As extensively documented in the literature, calcite dissolution occurring far-from-equilibrium results in surface topographies significantly different than at close-to-equilibrium conditions [2]. However, quantitative comprehensive characterisations of the surface roughening resulting from dissolution as a function of the degree of undersaturation are still lacking. In a recent study, we showed that, at close-to-equilibrium conditions ( $\Omega=0.6$ ), calcite surface roughness reaches a steady-state configuration, and we hypothesised that a relationship between saturation state and a statistical characterisation of the steady-state surface roughness may exist [3]. The present study shows experimental evidence supporting this hypothesis. We performed flow-through dissolution experiments at room temperature and atmospheric pCO<sub>2</sub> on mechanically-polished {104} calcite surfaces reacting at different saturation states with respect to calcite ( $0 \leq \Omega \leq 0.8$ ) in alkaline conditions (pH = 7.9). Each experiment lasted for 11 days, and surface topography images were acquired at different times during dissolution using vertical scanning interferometry. The resulting topography data were analysed with a variety of statistical techniques aimed to capture the surface roughness behaviour at different spatial scales [4]. In this respect, the Power Spectral Density computed, for each surface, at the final time, revealed a clear trend as a function of the saturation state, showing increasing roughness at all frequencies as the distance from equilibrium increases. Finally, we will discuss the potential of such results to: (i) back-estimate the alteration history of mechanically-polished calcite substrates; (ii) single out the impact of given chemicals on surface roughness resulting from dissolution; (iii) isolate the contribution of microbes to dissolution morphology.

[1] Bandstra & Brantley (2008), *Geochimica et Cosmochimica Acta*, 72 (11), 2587-2600

[2] Teng (2004), *Geochimica et Cosmochimica Acta*, 68 (2), 253-262

[3] Stigliano, Siena, Ackerer, Guadagnini & Daval (2021), *ACS Earth and Space Chemistry*, 5 (11), 3115-3129

[4] Mellot, Brantley & Pantano (2002), *The Geochemical Society, Special Public*, 7, 83-95