# Mineral deposition on the rough walls of a fracture

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The description of carbonate growth in fractures and pores is necessary for understanding carbon sequestration in the environment or in techniques of supersaturated solution injection into rocks. Calcite growth on fractures with rough walls of the same mineral is a simple but nontrivial problem which is studied here with kinetic Monte Carlo simulations of attachment and detachement of molecules and with scaling approaches. First, in initially wedge-shaped fracture walls whose upper terraces are in the same low energy (0,0,$\pm$1) planes, we show that the valleys are filled by the propagation of parallel monolayer steps in the wedge sides and that the growth ceases when the walls reach those low energy configurations. Thus, despite a possibly large initial roughness, a gap between the walls may not be filled. Secondly, we consider walls with equally separated monolayer steps (vicinal surfaces), in which the roughness is smaller than 1 nm, and show that growth by step propagation will eventually clog the fracture spacing. In both cases, scaling approaches predict the times to attain the final configurations as a function of the initial geometry and of the step propagation velocity measured in the chosen supersaturation. The same reasoning applied to random wall geometries shows that step propagation is also responsible for the lateral filling of surface valleys until the wall reaches the low energy crystalline plane that has the smallest initial density of molecules. Thus, the final wall configurations are much more sensitive to the wall crystallography than to the roughness or to the local curvature. The framework developed here may be used to determine those configurations, the times to reach them, and the mass of deposited mineral.

## Type

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