X-Ray tomography characterization of fracture surfaces during dissolution

Philippe Gouze, Catherine Noiriel[1], Céline Bruderer, Didier Loggia, and Richard Leprovost

Institut des Sciences de la Terre, de L'Eau et de l'Espace, CNRS - Université de Montpellier 2, France

Abstract. The changes of fracture surfaces geometry and extend are studied using X-ray micro-tomography during aperture increase due to CO_2-rich fluid percolation. Dissolution experiments were conducted on two micritic rock samples; one pure calcite end-member and one typical of the average composition for marine carbonates (85 % calcite). High-resolution digital images of the fracture geometry allow quantifying the surface properties changes over four spatial scales with a resolution of 4.91µm. Fracture surfaces are self-affine with an initial dimension of 2.5 ± 0.1. Dissolution of a pure-calcite sample is clearly a process of homogeneous chemical "erosion" of the surface elevation z: fractal dimension and specific surface remains constant (1.5 times the planar surface). Conversely, for the 85 % calcite sample, initial topographic surfaces of the fracture walls evolve rapidly toward "non-topographic" interfaces displaying overhangs due the preferential dissolution of the carbonate grains. In this case, the conventional definition of the effective aperture must be revisited. Such structures can only be assessed from 3D (tomographic) observations. As dissolution progresses, the specific surface increases strongly, more than 5 times the planar surface, and probably faster than the reactive surface.