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Calculating structural and geometrical parameters by laboratory experiments and X-Ray microtomography: a comparative study applied to a limestone sample

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The aim of this study is to compare the structural, geometrical and transport parameters of a limestone rock sample determined by X-ray microtomography (XMT) images and laboratory experiments. Total and effective porosity, surface-to-volume ratio, pore size distribution, permeability, tortuosity and effective diffusion coeffcient have been estimated. Sensitivity analyses of the segmentation parameters have been performed. The limestone rock sample studied here have been characterized using both approaches before and after a reactive percolation experiment. Strong dissolution process occured during the percolation, promoting a wormhole formation. This strong heterogeneity formed after the percolation step allows to apply our methodology to two different samples and enhance the use of experimental techniques or XMT images depending on the rock heterogeneity. We established that for most of the parameters calculated here, the values obtained by computing XMT images are in agreement with the classical laboratory measurements. We demonstrated that the computational porosity is more informative than the laboratory one. We observed that pore size distributions obtained by XMT images and laboratory experiments are slightly different but complementary. Regarding the effective diffusion coeffcient, we concluded that both approaches are valuable and give similar results. Nevertheless, we wrapped up that computing XMT images to determine transport, geometrical and petrophysical parameters provides similar results than the one measured at the laboratory but with much shorter durations.