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Representativeness of volume investigated by high-resolution X-ray computed tomography in damaged fine-grained rocks

Hugo Saur[1], Charles Aubourg[1], Peter Moonen[2], Pascale Sénéchal[2], Tiphaine Boiron[2], and Hannelore Derluyn[1]

[1]Université de Pau et des Pays de l'Adour, E2S UPPA, CNRS, Total, LFCR, Pau, France
[2]Université de Pau et des Pays de l'Adour, E2S UPPA, CNRS, DMEX, Pau, France

We focus on calcareous homogenous shales featuring different degrees of damage along a km-long strain gradient, marked by cleavage development. In a previous study, we used high-resolution X-ray computed tomography (µCT) to document the evolution of the 3D fabric of the fine-grained shales along the strain gradient (Saur et al., JSG, 2020). Our conclusions were based on samples of ~ 2.5 mm^3 containing over 10'000 quartz and calcite grains. The objective of the current study is to assess the representativeness of analyses on such small rock samples. To that extent, we first repeat the µCT analysis on multiple samples of the same, limited, volume and assess the variability of the results. These results are then compared to both macroscopic field observations and bulk fabric measurements obtained with AMS (Anisotropy of Magnetic Susceptibility) on larger samples (~ 10 cm^3). AMS provides a statistical description of the magnetic susceptibility tensor, and particularly the confidence angle of axis orientation. Generally, this confidence angle is the result of matrix organization and rock magnetism. In this study, AMS is only controlled by the presence of illite particles which reflect the matrix organization. Finally, we perform a subvolume analysis on the µCT images to determine the smallest representative volume characterizing the fine-grained fabric. In light of these analyses we discuss the representativeness of investigated volume of fine grained shales, subjected to different degrees of deformation.