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Multiscale porosity estimates of slates

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Determination of the porosity of slates gains wide interest, because slates become increasingly important in industries of underground storage and in shale gas exploration. Slates are the high-grade end-member of sheet-silicate-rich rocks and define a strongly anisotropic microstructure. Bulk rock measurements such as He-pycnometry and Mercury Intrusion Pycnometry (MIP) are common techniques to obtain a total connected porosity, but are poorly understood in terms of pore morphology. In this study, we aim understanding of the bulk rock porosity in terms of pore types and ascribe such pore types to underlying processes, along the PTt-deformation path, at the surface or induced artificially. Using image analysis on mechanical polished thin sections or BIB-SEM prepared sub-samples enables to divide the bulk rock porosity into matrix and fracture porosity. Image analysis on mechanical polished thin sections are biased by the artificial effects of mechanical polishing, but yield insight into the contribution of in-situ fractures. Most of these fractures are likely the effect of unloading during exhumation. In addition, image analysis on BIB-SEM prepared sub-samples yield the matrix porosity down to nm scale and are the often the effect of dissolution. Factors controlling porosity and pore morphology are mineralogy, sample homogeneity and strain. In addition, diagenetic processes, such as cementation and dissolution affect the porosity. Overlapping scales from nm to cm yield insight into the total pore network. Here we present a new multiscale workflow showing how to overlap these scales by combining bulk rock measurements and image analysis allowing to link the different pore types to their evolution over geological times scales.