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Impact of pore connectivity classification on mineral accessibility in sandstone samples

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Imaging has shown utility to identify and characterize the spatial distribution of minerals and capture pore structures in rock samples. Scanning electron microscopy (SEM) images, informed with elemental information from energy dispersive spectroscopy (EDS) images, can be used to create segmented mineral maps. Mineral volume fractions and accessibility can then be determined via quantitative image processing of the mineral maps. Mineral accessibility, the availability of mineral surfaces to reactive fluids, has shown to better reflect the reactivity of minerals in porous media samples compared to mineral abundance. Accessibility can be quantified from the produced mineral maps as the surfaces adjacent to connected porosity. Connected porosity can be determined in segmented mineral 2D images using a burning algorithm. However, only macropores can be captured in SEM images. Studies on clay minerals using focused ion beam-scanning electron microscopy (FIB-SEM), however, have shown that clays have abundant well-connected nano-porosity. The question is then, how important it is to consider nano pore connectivity while determining mineral accessibility? In this study, the impact of clay nano-porosity on pore connectivity and mineral accessibility is considered for seven sandstone samples with varying amounts of clay. Mineral abundances are determined by counting pixel counting in the segmented mineral maps, while mineral accessibilities are calculated by counting interfacial pixels of each phase. Three types of accessibility are considered: considering all macropores, considering only the connected macropores, and considering multi-scale connected porosity assuming connectivity via clay nanopores. The results show that consideration of nano pore connectivity has little impact for quartz and clay accessibilities, however higher impact on carbonate and feldspars. This study enhances understanding of mineral accessibility in sandstone samples which can be used to improve accuracy of reactive transport simulations.