Dual energy CT to identify minerals at the pore-scale

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Reactive surface area is thought to be an important control on the rates of interfacial processes occurring between minerals and aqueous solutions with direct implications to reactive transport modelling. This work is focused on identifying and differentiating minerals using CT imaging to characterise reactive transport controls such as mineral-specific reactive-surface-area. In this study, we assess the use of dual-energy micro-tomography to resolve pore-scale distribution of different minerals. The diffculty with current single energy micro-tomography methods is in differentiating similarly attenuating minerals such as kaolinite, K-feldspar and quartz in Berea sandstone for example. The dual-energy method provides two 3D CT images: one at high beam energy and one at low beam energy. When different minerals conspire to have similar attenuation responses at one energy by unique combinations of their photoelectric effect and Compton scattering, then their contrast can be improved by moving to a different energy where the relative contribution of the photoelectric effect and Compton scattering changes significantly, thus changing their relative attenuation response. However there is blurring of the x-ray response due to lower pixel resolution and x-ray counts imposed by the use of the dual-energy method, making it difficult to resolve the signature response of each mineral. This study incorporates dual energy data with grain-averaging to address the noise issue. Given each grain has a Gaussian distribution of CT values, taking the mean CT for each grain collapses it to a single value. However, neither the high-energy nor low-energy images offer satisfactory pixel resolution to resolve the grain contacts in order to separate the grains. Therefore a high-resolution image was used to identify the separate grains and correlating their location to composition information from the low-resolution dual energy images. Results identifying different mineral groups are presented for a sandstone and carbonate rock. These two rock types are important for carbon storage applications that involve chemical interactions between injected CO_2, formation water and host rock.