Geophysical Research Abstracts
Vol. 17, EGU2015-3829, 2015
EGU General Assembly 2015

Pore Scale Heterogeneity in the Mineral Distribution and Surface Area of Porous Rocks

Peter Lai (1,2) and Sam Krevor (1,2)

(1) Earth Science and Engineering, Imperial College London, United Kingdom (p.lai12@imperial.ac.uk), (2) Qatar Carbonates and Carbon Storage Research Centre, Imperial College London, United Kingdom

An important control on rate of interfacial processes between minerals and aqueous solutions such as nucleation of solids, and mineral dissolution and growth is reactive surface area. In geochemical modelling, the continuum hypothesis is based on the assumption that the system can be represented by a sufficiently large number of representative elemental volumes. There has been recent interest in studying the impact of this assumption on reaction-transport coupled systems. In this study, the impact of pore-scale heterogeneity on the distribution of reactive surface area is discussed. 3D images obtained using x-ray micro-tomography were used to characterise the distribution of reactive surface area. The results were compared to independent observations. Mineral identification using x- ray diffraction and fluorescence suggested general agreement with CT analysis. Nitrogen BET surface areas were one to two orders of magnitude higher than measurements from x-ray imagery. Co- registered images of Berea sandstone from x-ray and energy dispersive spectroscopy imagery suggested that quartz, K-feldspar and most clays could be identified. However, minor minerals such as albite and illite did not exhibit enough contrast. In Berea sandstone, mineral surface area fraction was poorly correlated to the mineral volumetric fraction. Clay and feldspar minerals exhibited higher surface area fractions than bulk mineralogy suggested. In contrast, in the Edwards carbonate samples, modal mineral composition correlated with mineral-specific surface area. Berea sandstone revealed a characteristic pore size at which a surface area distribution may be used to quantify heterogeneity. Conversely, the carbonate samples suggested a continuous range of pore sizes across length scales. A comparison with pore network model simulations from the literature was made. First order estimates of mineral specific correlations between geometric area measured in the x-ray images were used to convert the CT derived surface area distributions to BET-equivalent distributions. The CT-BET comparison indicated constrains in mineral-specific roughness ratios of 130 for clays and 13 for all other minerals. The distribution of surface area to pore volume ratio reported in the literature suggested that surface area and pore volume were spatially coupled. The impact of pore-scale heterogeneity was discussed.