Geophysical Research Abstracts
Vol. 16, EGU2014-12694, 2014
EGU General Assembly 2014

Pore scale heterogeneity in the mineral distribution and surface area of porous rocks

Peter Lai (1,2), Kevin Moulton (1), Samuel Krevor (1,2)

(1) Department of Earth Science & Engineering, Imperial College London, London, United Kingdom , (2) Qatar Carbonates and Carbon Storage Research Centre, Imperial College London, London, United Kingdom

There are long-standing challenges in characterizing reactive transport in porous media at scales larger than individual pores. This hampers the prediction of the field-scale impact of geochemical processes on fluid flow [1]. This is a source of uncertainty for carbon dioxide injection, which results in a reactive fluid-rock system, particularly in carbonate rock reservoirs. A potential cause is the inability of the continuum approach to incorporate the impact of heterogeneity in pore-scale reaction rates. This results in part from pore-scale heterogeneities in surface area of reactive minerals [2,3]. The objective of this study was to quantify heterogeneity in reactive surface and observe the extent of its non-normal character. In this study we describe our work in using micron-scale x-ray imaging and other spectroscopic techniques for the purpose of describing the statistical distribution of reactive surface area within a porous medium, and identifying specific mineral phases and their distribution in 3-dimensions. Using in-house image processing techniques and auxilary charactersation with thin section, electron microscope and spectroscopic techniques we quantified the surface area of each mineral phase in the x-ray CT images. This quantification was validated against nitrogen BET surface area and backscattered electron imaging measurements of the CT-imaged samples. Distributions in reactive surface area for each mineral phase were constructed by calculating surface areas in thousands of randomly selected subvolume images of the total sample, each normalized to the pore volume in that image. In all samples, there is little correlation between the reactive surface area fraction and the volumetric fraction of a mineral in a bulk rock. Berea sandstone was far less heterogeneous and has a characteristic pore size at which a surface area distribution may be used to quantify heterogeneity. In carbonates, heterogeneity is more complex and surface area must be characterized at multiple length scales for an accurate description of reactive transport.

[1] Maher, Steefel, Depaolo and Vianni (2006) Geochimica et Cosmochimica Acta, 70, 337-363 [2] Landrot, Ajo-Franklin, Yang, Cabrini and Steefel (2012) Chemical Geology 318-319, 113-125 [3] Li, Peters and Celia (2007) American Journal of Science 307, 1146-1166