



Surface area changing during CO₂ water-mineral interaction: an inverse modelling approach

A. Rocha Scislewski (1) and P. Zuddas (2)

(1) Institut de Physique du Globe de Paris, Paris, France (scislewski@ipgp.jussieu.fr), (2) Département Sciences de la Terre, Université Claude Bernard Lyon1, France (zuddas@univ-lyon1.fr)

Several physical and chemical mechanisms control the potential storage of CO₂ in geological media. The CO₂ dissolution in the aquifers produces a decreasing on pH enhancing the dissolution of minerals present in the host rock. This complex process consists on a set of reactions that produces an increase in the fluid alkalinity and facilitates the formation of metal complexes in solution. Reactions of gas dissolution and mineral trapping are considerably slow but their relative effectiveness may be increased over longer time frames given a faster sequestration. The reactive mineral surface area, representing the area that really participates on the overall process, is difficult to estimate. In this work, we applied a conceptual model to estimate the mineral surface area participating in the reaction of dissolution-precipitation during the geochemical interactions in multi-mineral systems using water chemistry data.

In our schematic modeling, the chemical evolution of the dissolved phases is reconstructed with a reaction progress chart defined by a fractional degree of advancement (ζ) of the irreversible mass-transfer process and attaining the continuum limit during water-rock interaction. The system is solved in terms of a transported reaction rate vector, introducing the experimental rate constants for every single mineral and solving for the surface areas of dissolving plagioclase, biotite, k-feldspar and calcite. This is done assuming the activities of dissolved silica and aluminum ions as constrained by the instantaneous equilibrium with quartz and kaolinite.

We applied our modeling to previous analytical results of a flow-through experiment carried out with Caetité (Brazil) granite samples, at the temperature of 22° +/- 2°C and using fluids at different CO₂ fugacity. Preliminary results indicate that the surface area dramatically changes by several orders of magnitude during several months of interactions for albite and biotite minerals. In addition, this inverse modeling approach reveals that the changing in the surface area is about 3-4 orders of magnitude higher when compared to the mineral dissolution rate variation.