"Push-pull" reactive tracer tests simulations with reactive multirate models to infer geochemical processes during CO_2 injection

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In order to design the field tests to be held in Hontomín (north of Spain), a future pilot site for carbon sequestration, "push-pull" test simulations are being conducted with the aim of characterizing the formation before starting the CO_2 injection. Single well injection-withdrawal, "push-pull", tests have been widely used to obtain information on a large variety of physical, biological and chemical aquifer characteristics. This type of test consists of injecting a solution, either reactive or not, into a well followed by an extraction from the same well. If a reactive solution is used, the geochemical reactions occurring in the aquifer can be identified and quantified. Therefore, useful insights on porosity and permeability changes are provided.

After modeling "push-pull" tests with single and double porosity models, using the geological and geochemical data available for the zone of interest, we investigated the ability of multiple-rate diffusion models to reproduce reactive single-well injection withdrawal tests. Multirate diffusion models can be considered a generalization of the double porosity model in the sense that they simulate the behavior of two zones, the first characterized by high porosity values ("mobile" advective zones) and the other with lower porosity ("immobile" diffusive regions), but the diffusion coefficients are described by a distribution instead of a single value. The results suggest that reactive multirate mass transfer models are particularly useful to simulate tests conducted in highly fractured media and provide useful insights on geochemical processes and especially on their kinetic properties, such as mineral dissolution/precipitation rate. Besides, the matrix diffusion effects are appreciable and can be represented well with a multiple porosity model. Moreover, since

a quite aggressive solution should be used in order to notice the effects of the injection, according to the simulations conducted, an accurate analysis of the water geochemical composition could be useful also to evaluate damages, potentially dangerous, on the well structure.