

The paper addresses a very timely and relevant topic in reactive transport through heterogeneous porous media. The most significant and novel result concerns the significant changes in non-Fickian transport behaviors while the while velocity variance display modest variations.

The topic is suitable for HESS and I recommend minor revisions related to:

- The chemical model is a very simplified description of dissolution/precipitation processes. It should be better justified through additional references (see references below) and some quantitative information should be provided to describe its field of application. Without this information, the paper may appear like discussion around numerical experiments. Furthermore, the 'strange' dimension of the domain (60 x 24 cm<sup>2</sup>) seems related to a lab. scale experiment....
- A key parameter in dissolution/precipitation is the surface at the interface between solid and fluid, which is insufficiently discussed in the paper. Porosity and hydraulic conductivity are modified by precipitation/dissolution. What about the area in contact with the fluid?
- 20 random realizations is a limited number of realizations... Can you discuss this number a posteriori, i.e. by analyzing the variability within realizations?
- The particles are injected at regular time interval. Do they all start at the same time or is the injection time uniformly distributed over the time step?
- I do not understand why there is the number 3 in formula line 153.
- I assume that the 20 minutes are for the initial pore volume (L234) ?

References:

Lichtner, The quasi-stationary state approximation to coupled mass transport and fluid-rock interaction in a porous medium, GCA, 1988

Dreybrodt et al., The kinetics of the reaction  $\text{CO}_2 + \text{H}_2\text{O} + \text{H}^+ + \text{HCO}_3^-$ , as one of the rate limiting steps for the dissolution of calcite in the system ..., GCA, 1996