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Monte Carlo based NMR simulations of open fractures in porous media

Tamás Lukács and László Balázs
ELTE, Department of Geophysics and Space Science, Hungary (lukacs.tom@gmail.com)

According to the basic principles of nuclear magnetic resonance (NMR), a measurement's free induction decay curve has an exponential characteristic and its parameter is the transversal relaxation time, T2, given by the Bloch equations in rotating frame. In our simulations we are observing that particular case when the bulk's volume is neglectable to the whole system, the vertical movement is basically zero, hence the diffusion part of the T2 relation can be editted out. This small-apertured situations are common in sedimentary layers, and the smallness of the observed volume enable us to calculate with just the bulk relaxation and the surface relaxation. The simulation uses the Monte-Carlo method, so it is based on a random-walk generator which provides the brownian motions of the particles by uniformly distributed, pseudorandom generated numbers. An attached differential equation assures the bulk relaxation, the initial and the iterated conditions guarantee the simulation's replicability and enable having consistent estimations. We generate an initial geometry of a plain segment with known height, with given number of particles, the spatial distribution is set to equal to each simulation, and the surface-volume ratio remains at a constant value. It follows that to the given thickness of the open fracture, from the fitted curve's parameter, the surface relaxivity is determinable. The calculated T2 distribution curves are also indicating the inconstancy in the observed fracture situations. The effect of varying the height of the lamina at a constant diffusion coefficient also produces characteristic anomaly and for comparison we have run the simulation with the same initial volume, number of particles and conditions in spherical bulks, their profiles are clear and easily to understand. The surface relaxation enables us to estimate the interaction beetwen the materials of boundary with this two geometrically well-defined bulks, therefore the distribution takes as a basis in estimation of the porosity and can be use of identifying small-grained porous media.