Time dependence of reprecipitation rates in heterogeneous media DANIEL REEVES, DANIEL ROTHMAN, MIT — The analysis of spatial and temporal variations of the chemical and isotopic compositions of minerals in sedimentary systems provides a powerful tool for calculating dissolution and reprecipitation rates, and has previously been applied to find time-dependent rates in marine sediments. Dissolution and precipitation processes tend to shift the composition of the pore fluids toward that of the solid phase, and vice-versa. Current theory treats both the fluid and solid phases as well-mixed reservoirs, relying on mean-field theory that is inconsistent with the physical structure of the solid, as dissolution and precipitation occur only on the reactive surface of the solid. We present a model that accounts for the heterogeneity of the solid phase by adding and removing material only at the reactive surface. We therefore model the location of the surface with a 1-D random walk, in which the buried bulk of the solid phase can only be modified through repeated dissolution events. We approximate this physical scenario with a three-reservoir kinetic model and more detailed numerical simulations. We develop an understanding of two power-law scaling regimes, the second of which demonstrates 1/time aging in the rate constant, similar to those observed in marine sediment studies.

Daniel Reeves
MIT