Account of cationic exchange in the nucleation and growth of minerals in aqueous solutions

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Ion exchange in mineral phases is a very important geochemical process which takes place in many natural systems (soils, geological reservoirs, etc), and which concerns both major and minor ions present in most of the natural solutions in contact with mineral phases possessing a cation exchange capacity. It may control the transfer or fixation of cations of interest in many environmental problems.

From the simulation point of view, the challenge is to include, in the same simulation tool, several kinetic processes with largely different time scales: quasi-instantaneous cationic exchange near equilibrium and longer term mineral precipitation.

We have extended our recently developed Nanokin code [1-3], which can describe the dissolution of primary minerals as well as the kinetics of precipitation of secondary minerals of fixed or variable composition, in order to account for ionic exchange processes. The approach is very similar to the one used for the precipitation of solid solutions, except for the time dependence of the cation fraction in the solid phase, which is assumed to be in equilibrium with the instantaneous state of the aqueous solution.

With this extension, the code Nanokin is able to simulate the formation of clay phases, by combining nucleation and growth in the oversaturation domain, together with cation exchange inside the newly formed particles.

We present the main lines of the theoretical approach, together with some first applications for Na/K and Ca/Mg exchange in simple clay phases during their precipitation.

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Ediacaran oceanic environmental change inferred from Pb, Sr isotopes and REE geochemistry of the Baratal limestone, Gorny Altai Mountains, Southern Siberia

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We report a Pb-Pb errorchron age, Sr isotope variation, and REE geochemical characteristics on the Ediacaran mid-oceanic Baratal limestone which occurs in Gorny Altai Mountains, Southern Siberia as enclosed block in a Cambrian accretionary complex [1, 2]. The Ediacaran is regarded as a cradle for the Cambrian radiation, and also the time of breakup of the Rodinia. The occurrence of the Baratal limestone gives a unique opportunity in evaluating global oceanic environment of those days because they do not involve any terrigenous components due to be isolated geographic condition from continents.

Judging from the present-day Mn/Sr and Rb/Sr ratios of the samples, they seem to preserve their original geochemical characteristics [2]. A Pb-Pb isotope analysis define an errorchron of 595±41 Ma (MSWD:11.9) for the samples from the whole stratigraphic succession. The large error may be attributed to poor signal of TIMS due to very small amount of Pb in the samples. Sr isotopes show a wide variation from 0.7059 to 0.7077, which seems to correspond with the event of Ediacaran oceanic environmental change due to redistribution of plates. With the variation of Sr isotope, REE are characterized by their high concentrations and show variable patterns.

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