Kinetics of kaolinite precipitation at the laboratory and field scale

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The precipitation of clay minerals during water-rock interaction exerts an important control on solution composition, and thus the rate of dissolution of primary phases. In this regard, it is essential to quantify the precipitation kinetics of the clays, and particularly those of kaolinite. Dissolution and precipitation rates of low defect Georgia kaolinite as a function of Gibbs free energy of reaction were measured at 22°C and pH 4 in continuously stirred flow through reactors. Dissolution and precipitation rates determined at steady state could not be described with the same rate law—dissolution was described well by a Transition State Theory (TST) rate formulation with a Temkin coefficient of 2, while precipitation rates at steady state were not reversible with the dissolution rates and were described better by a 2D nucleation rate law [1].

Kaolinite precipitation rates at circumneutral pH conditions may be too slow to measure in the laboratory, so we have attempted to estimate these at the field scale using reactive transport modeling. The weathering simulations consider conditions similar to those at the Santa Cruz chronosequence, with dissolution of primary feldspar leading to the precipitation of kaolinite. Matching of both pore water chemistry and mineral abundances at the site provides an estimate of the kaolinite precipitation rate, although the rate constant itself is poorly constrained due to uncertainty in the solubility of the actual kaolinite phase that forms. In addition, the solubility of this phase appears to decrease with time.

[1] Yang and Steefel (2008) *Geochim. Cosmochim. Acta* **72**, 99-116.

Study on $CaCO_3$ crystal structure and its environmental information of carp asteriscus from Miyun Reservoir and Baiyangdian Lake

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In the past fifty years, many achivements had made in the crystal structure research of $CaCO_3$ in the otoliths of fish, especial sea fish. Nevertheless, rare study had made that of Carp. Our research reveals that $CaCO_3$ in the asteriscus of Carp is vaterite polymorphs, and its crystal structure seems sensitive to water quality and water environment, maybe being a potential proxy for monitoring water quality change. Samples of carp were collected from Baiyangdian Lake, suffering from serious intermittent pollution, and Miyun Reservoir, supplying drink water for Beijing, which is little polluted. Both of these waters are located in northern China. The minerals in cores and edges were sampled seperately and tested by XRD. The results demonstrate that nearly all peaks of every sample from both localities are matched very well with one of these three standards in the JCPDS, synthetic vaterite with Pbnm space group (no.74186), synthetic vaterite with P63/mmc space group (no.720506), and vaterite with P63/mmc space group (no.330268). Though no obvious defference in $CaCO_3$ polymorphs within asteriscus from both locality at large, clear differences exist in dimensions of crystalline cells of vaterites within these samples from two sites. The dimensions of crystalline cells of vaterites in the otoliths from the Miyun reservoir are much nearer to the standards than those from the Baiyangdian lake, and a_0 of the former is relatively bigger than the latter, but things are opposite for c_0. Moreover, the cell volume of vaterite from the Miyun reservoir is bigger than that from the Baiyangdian lake, and the former is nearer to the standards than the latter. It maybe shows that the differences in the dimensions from the two localities are probably consistent with the differences in the microchemical compositions of vaterites from these localities, because the contents of elements Sr, Ba, Zn, As in the asteriscus otoliths from Miyun reservoir are lower than these from Baiyangdian river.

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