Unidirectional kaolinite dissolution rates at near-equilibrium and near-neutral pH conditions using Si isotope tracers

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We measured unidirectional kaolinite dissolution rates at near-neutral-pH and close-to-equilibrium conditions by introducing a rare Si isotope ^{29}Si into the experimental solutions. Reaction rates were tracked by $^{29}Si/^{28}Si$ ratios of reacted solutions. Because the precipitation of Si-containing secondary phases or the reverse reaction consume silica but leaves the ^{29}Si /^{28}Si ratios essentially unchanged in experimental solutions, dissolution rates were still measurable when secondary phase precipitation took place in experiments. Results from experiments for albite, K-feldspar, quartz, and kaolinite (Liu et al., 2016; Zhu et al., 2016; Gong et al., 2019; Zhu et al. 2020) demonstrated that the isotopic contrast and analytical precision allow detection of the dissolution of a minute amount of silicate.

We also demonstrated that Quadrupole inductively coupled plasma mass spectrometry (Q-ICP-MS) provide sufficient precision for measuring ^{29}Si /^{28}Si ratios for kinetics experiments. We compared the results of MC-ICP-MS and Q-ICP-MS measurements of the $^{29}Si/^{28}Si$ ratios in experimental solutions. Student t-test showed that the rates calculated from the two analytical data sets have no statistically significant differences at the 95% confidence level.

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