Calcium isotope fractionation during bacterially mediated carbonate precipitation

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The metabolic activity of microbial communities in marine sediments changes the local chemistry and thus influences mineral precipitation and dissolution within sedimentary environments. In particular, the activity of sulfate-reducing bacteria generates alkalinity and can raise local pH, driving sedimentary carbonate precipitation. To better understand the link between calcium carbonate precipitation and sulfate-reducing bacteria metabolism, we have explored the calcium isotope fractionation during the precipitation of calcium carbonate in pure cultures of the marine sulfate-reducing bacteria *Desulfovibrio bizertensis*. We show that there are different calcium isotope fractionation factors during bacterially mediated carbonate mineral precipitation that are calcium carbonate polymorph specific.

Then, bacterial growth was modulated using an antibiotic (ampicillin) and the evolution of $\delta^{44}Ca$ in solution was monitored under several different growth rates. The resulting calcium isotope fractionation shows that the growth rate of the bacteria controls the oversaturation of the fluid with respect to calcium carbonate, and this growth rate influences the calcium isotope fractionation factor during carbonate mineral precipitation.

The rate of calcium isotope exchange between the precipitated mineral solid and the fluid phase, which occurs in the latter stages of the incubation, has been modelled. The modelling reveals high rates of calcium isotope exchange between the solid and fluid phase, which suggests there can be a rapid overprinting of the original calcium isotope signature from precipitation in microbially mediated carbonate mineral precipitation.