

Out of equilibrium $\delta^{18}\text{O}$ and variable $\delta^{13}\text{C}$ as a tracer of metabolism in bacterially mediated carbonates.

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Oxygen and carbon stable isotope compositions of carbonates are widely used to provide information on their conditions of precipitation. Some carbonates resulting from an eukaryotic biological activity have been shown to lead to isotopic characteristics that differ from those expected for isotope equilibrium with their environment. The origin of this difference remains poorly understood and is referred to as the “vital effect”. Very little is known on the effect that bacterial communities precipitating carbonates produce on their $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$. We performed an isotope study of carbonate precipitation by *Sporosarcina pasteurii*, a bacterial model of carbonatogen metabolisms. Its ureolytic activity produces ammonia (thus increasing the pH) and dissolved inorganic carbon that precipitates as solid carbonates. We realized four biomineralisation experiments with bacteria in variable physiological states. $\delta^{18}\text{O}_{\text{CaCO}_3}$ results showed values up to 20‰ lower than what is expected for carbonate precipitation in equilibrium with water and we identified a 5‰ variability in the $\delta^{13}\text{C}$ recorded by carbonates. A close-box modelling taking into account C-isotopic reactions on the one hand, and the addition of carbonic anhydrase in our experimental setup on the other hand, allowed us to identify that $\delta^{13}\text{C}_{\text{CaCO}_3}$ and $\delta^{18}\text{O}_{\text{CaCO}_3}$ signals respectively, were directly correlated to metabolic activity. Our study evidences a bacterial vital effect on oxygen and carbon isotopes in bacterial carbonates, which controlling mechanisms may be also occurring in other biologically mediated carbonates.