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Magnesium isotope fractionation during natural travertine precipitation: an example from Baishuitai system (Yunnan, SW China).

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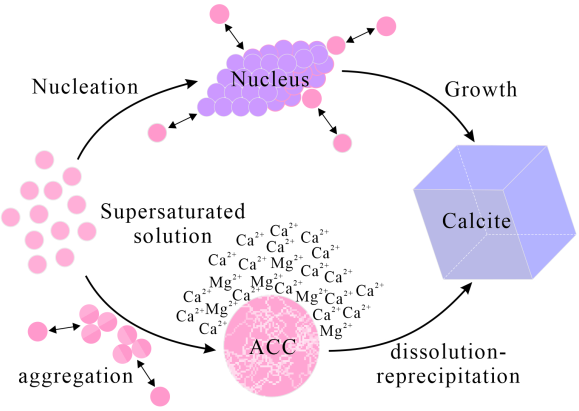

Travertine deposited in Earth's surface environments is an important geological archive for paleo-climatic reconstruction. As magnesium (Mg) is a common element in carbonates, Mg isotope composition would provide useful information for studying paleo-climate evaluation history. However, until recently, studies focused mainly on laboratory experiments and reported inconsistent results on Mg isotope fractionation between Mg-calcite and aqueous solutions [1], highlighting further systematic research especially on the natural system.

Here, we investigate Mg isotope fractionation associated with calcite precipitation in the natural endogenic travertine deposition system, with samples collected along the canal at Baishuitai (Yunnan, SW China). The results display large $\delta^{26}Mg$ variation from -1.37 to -1.26‰ for the water samples, while relatively constant value for the solid travertine, and clear Mg isotope fractionation, with $\Delta^{26}Mg_{solid\text{-}solution}$ values ranged from -2.76 to -2.59‰ (mean value of -2.69‰). All natural travertine samples are thus enriched in ^{24}Mg compared to the water solution, in accord with previous experimental studies. All geochemical data strongly suggest a kinetic Mg isotope fractionation, rather than the equilibrium [2][3]. The Mg isotope variation along the canal could be eventually explained by the transition of Mg incorporation patterns downstream, with the direct coprecipitation of Mg cations into rapidly formed calcite at upstream, while an incorporation of Mg into the carbonate through an intermediate Mg-rich amorphous calcium carbonate (ACC) formation at downstream. Though the relatively small temperature variation don't allow us to explore the temperature effect, as previous research [4], our study indicates clearly the usefulness of Mg isotopes in surface carbonate archives for reconstructing the paleo-climate, and noticeably the relative formation processes and mechanisms.

References: [1] Mavromatis et al. (2013), Geochim Cosmochim Acta 114, 188-203. [2] Young and Galy. (2004), Rev Mineral Geochem 55, 197-230. [3] Schott et al. (2016), Chem Geol 445, 120-134. [4] Li et al. (2012), Earth Planet Sci Lett 333-334, 304-316.