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Effect of growth rate on Zn incorporation in calcite and aragonite

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The chemical and isotopic composition of $CaCO_3$ minerals records the environmental conditions in which these minerals were formed. Thus, the mechanisms controlling the incorporation of traces/impurities in calcite and aragonite and more recently their stable isotopes have been widely studied to develop new paleoenvironmental proxy tools. The chemical and isotopic composition of natural carbonates however, is affected by numerous processes, including mineralogy, aqueous complexation and biological activity. Thus, deciphering the extent each parameter excerpts in mineral chemical/isotopic composition becomes complicated. This observation holds especially true for Zn, an element which exhibits a high affinity for organic and inorganic ligands in natural waters. In this study we examine the effect of growth rate on the Zn incorporation in calcite and aragonite formed under controlled abiotic conditions. The experiments were performed at pH 6.3 and 8.3 with mineral growth rate (r_p) varying in the range $10^{-8.06} \leq r_p \leq 10^{-7.19}$ (mol/m²/s) for both calcite and aragonite. Incorporation of Zn in calcite is characterized by an elevated partitioning coefficient (D_{Zn} ~40), while D_{Zn} takes values below 1 in aragonite. A negative correlation between D_{Zn} and growth rate was recorded for calcite experiments at pH 6.3 with D_{Zn} values decreasing from ~65 to ~40 when r_p increased from $10^{-8.0}$ to $10^{-7.1}$ mol/m²/s. An opposite trend was observed for aragonite at pH 6.3 with D_{Zn} values increasing from ~0.04 to ~0.84 at increasing r_p from $10^{-8.58}$ to $10^{-7.34}$ mol/m²/s. Both trends agree with previous works on divalent cation incorporation in $CaCO_3$ minerals as a function of growth rate. These new findings will shed light on the processes controlling the Zn incorporation in calcite and aragonite and explore the interest of Zn as a proxy tool.