

## Factors favoring precipitation of CaCO<sub>3</sub> as calcite or as aragonite

Factor	Observed effect on precipitation of CaCO <sub>3</sub>	Environmental considerations	Implications for natural precipitation of CaCO <sub>3</sub> as <i>aragonite</i> or <i>calcite</i>
Presence of sulfate (SO <sub>4</sub> <sup>2-</sup> ) in solution	Inhibits precipitation of both calcite and aragonite, apparently by surface adsorption. Inhibition is greater for calcite than for aragonite (Walter, 1986).	Much SO <sub>4</sub> <sup>2-</sup> in seawater; little in meteoric water	Favor precipitation of <i>aragonite</i> from modern seawater
Presence of magnesium (Mg <sup>2+</sup> ) in solution	Inhibits precipitation of calcite at concentrations as low as 5% of those in seawater (Berner, 1975), apparently via adsorption of hydrated Mg <sup>2+</sup> on calcite surface. Has no effect on aragonite.	Much Mg <sup>2+</sup> in modern seawater; little in meteoric water	Favor precipitation of <i>aragonite</i> from low-latitude shallow seawater
Precipitation rate (or supply of carbonate ion)	Greater rate of precipitation favors aragonite (Given & Wilkinson, 1985)	Warm agitated seawater loses CO <sub>2</sub> and so allows faster precipitation; saturation state of non-karst groundwater can only change slowly	Favor precipitation of <i>aragonite</i> in at least some speleothems and travertines
Temperature	Higher temperature favors precipitation of aragonite rather than calcite (Walter, 1986)	Low-latitude seawater is warm	Favor precipitation of <i>aragonite</i> in at least some speleothems and travertines
Presence of phosphate (PO <sub>4</sub> <sup>2-</sup> or more complex forms) in solution	Inhibits precipitation of both calcite and aragonite, apparently by surface adsorption. Inhibition is much greater for aragonite than for calcite (Walter, 1986).	PO <sub>4</sub> <sup>3-</sup> in seawater is consumed by photosynthesizers, so small concentration makes it irrelevant there. Very significant to wastewater and polluted waters.	Favor, or at least allow, precipitation of <i>calcite</i> from meteoric waters (e.g., as cements in limestones)
Presence of dissolved organic carbon (DOC) in solution	Inhibits precipitation of at least calcite (Lebron & Suarez, 1996) (little data regarding aragonite).	Present in at least low concentration in all earth-surface waters; less abundant in shallow groundwater	Decreased nucleation rate favors <i>coarse equant calcite</i> in burial cements in limestones
Presence of iron (Fe <sup>2+</sup> ) in solution	Inhibits precipitation of calcite at very low concentrations (Meyer, 1984)	Present in deeper (and thus anoxic) groundwater	

**Summary:** *Combination of the factors above helps to explain the dominance of aragonite in modern marine sediments, especially those from warm shallow waters, and the dominance of calcite in meteoric cements in limestones.*

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