Saturation

Solubility product, K_{sp}, describes equilibrium between a solid and its ions in solution

$$[Cation][Anion] \overset{K_{sp}}{\rightleftharpoons} [Cation^+] + [Anion^-]$$

$$K_{sp} = \frac{[Cation^+][Anion^-]}{1}$$

Consider carbonate solubility

$$CaCO_3 \rightleftharpoons [Ca^{2+}] + [CO_3^{2-}]$$

$$K_{sp} = [Ca^{2+}][CO_3^{2-}]$$ ← when product higher than K_{sp}, solid will precipitate to reach equilibrium. ... if product lower, will dissolve.

$CaCO_3$ comes as two main mineral phases in the ocean: Aragonite, Calcite

- minerals have different K_{sp}

Calcite: $K_{sp} = 10^{-6.37}$ Aragonite: $K_{sp} = 10^{-6.19}$ ← which mineral is more soluble in seawater? "easily dissolved"

Aragonite more soluble → higher K_{sp}

Omega, Ω, saturation state

$$\Omega = \frac{[Ca^{2+}][CO_3^{2-}]}{K_{sp}}$$

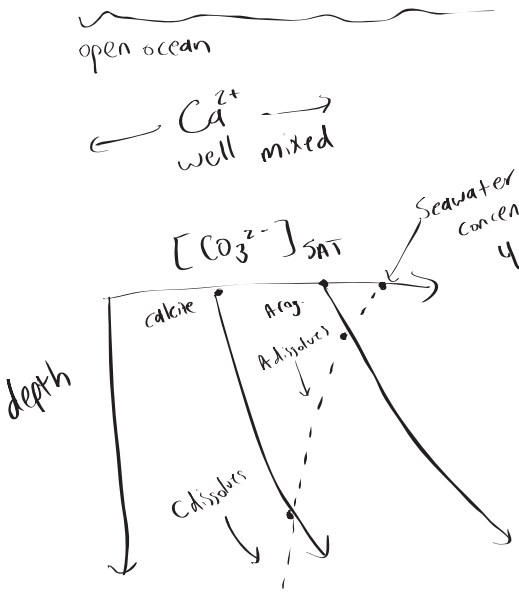
$\Omega = 1$ equilibrium
$\Omega < 1$ undersaturated → will dissolve
$\Omega > 1$ super saturated → will precipitate

$f(T, P)$

Ω mostly depends on $[CO_3^{2-}]$ and K_{sp}

$[CO_3^{2-}]_{sat}$ of saturated ($\Omega = 1$) seawater, μmol/kg

T°C	Patm	Calcite	Aragonite
25°	1	41.6	63
2°	1	41.9	67
2°	250	69.4	107
2°	500	111.7	167



K_{sp} ↗ with pressure

K_{sp} ↘ with T

★ Surface ocean $[CO_3^{2-}] \approx 200 \frac{\mu mol}{kg}$