

Kinetics of Carbonate Mineral Dissolution in CO₂-Acidified Brines at Storage Reservoir Conditions

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Supplementary Data

Table S1. Initial dissolution rates r of calcite minerals in (CO₂ + H₂O + NaCl) systems at temperatures T

Medium	T (K)	P (MPa)	r (mol·m ⁻² ·s ⁻¹)
CO ₂ + H ₂ O + NaCl (2.5 mol·kg ⁻¹)	325.15	6.0	5.9 × 10 ⁻⁴
CO ₂ + H ₂ O + NaCl (2.5 mol·kg ⁻¹)	353.15	6.0	8.4 × 10 ⁻⁴
CO ₂ + H ₂ O + NaCl (2.5 mol·kg ⁻¹)	373.15	6.0	1.1 × 10 ⁻³
CO ₂ + H ₂ O + NaCl (5 mol·kg ⁻¹)	325.15	6.0	4.8 × 10 ⁻⁴
CO ₂ + H ₂ O + NaCl (5 mol·kg ⁻¹)	353.15	6.0	8.1 × 10 ⁻⁴
CO ₂ + H ₂ O + NaCl (5 mol·kg ⁻¹)	373.15	6.0	8.0 × 10 ⁻⁴

Table S2. Activities α of H⁺ and CO₂ in different aqueous media at temperatures T and pressures P calculated with PHREEQC version 3.1.4.

Medium	T (K)	P (MPa)	α_{H^+}	α_{CO_2}
CO ₂ + H ₂ O	325.15	6.0	6.7 × 10 ⁻⁴	8.3 × 10 ⁻¹
CO ₂ + H ₂ O	353.15	6.0	5.4 × 10 ⁻⁴	6.1 × 10 ⁻¹
CO ₂ + H ₂ O	373.15	6.0	4.5 × 10 ⁻⁴	5.3 × 10 ⁻¹
CO ₂ + H ₂ O + NaCl (2.5 mol·kg ⁻¹)	325.15	6.0	9.9 × 10 ⁻⁴	8.3 × 10 ⁻¹
CO ₂ + H ₂ O + NaCl (2.5 mol·kg ⁻¹)	353.15	6.0	7.2 × 10 ⁻⁴	6.1 × 10 ⁻¹
CO ₂ + H ₂ O + NaCl (2.5 mol·kg ⁻¹)	373.15	6.0	5.6 × 10 ⁻⁴	5.3 × 10 ⁻¹
CO ₂ + H ₂ O + NaCl (5 mol·kg ⁻¹)	325.15	6.0	1.4 × 10 ⁻³	8.3 × 10 ⁻¹
CO ₂ + H ₂ O + NaCl (5 mol·kg ⁻¹)	353.15	6.0	9.7 × 10 ⁻⁴	6.1 × 10 ⁻¹
CO ₂ + H ₂ O + NaCl (5 mol·kg ⁻¹)	373.15	6.0	7.2 × 10 ⁻⁴	5.3 × 10 ⁻¹

Table S3. Initial dissolution rates r of dolomite and carbonate reservoir analogue minerals in different aqueous media at temperatures T and pressures P ; $r(\text{Ca}^{2+})$ and $r(\text{Mg}^{2+})$ refer to the rates measured for Ca^{2+} and Mg^{2+} respectively

Mineral	Medium	T (K)	P (MPa)	$r(\text{Ca}^{2+})$ ($\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$)	$r(\text{Mg}^{2+})$ ($\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$)
Dolomite	HCl (0.01 M)	353.15	0.1	1.0×10^{-3}	9.2×10^{-4}
Dolomite	HCl (0.01 M)	343.15	0.1	8.5×10^{-4}	7.5×10^{-4}
Dolomite	HCl (0.007 M)	333.15	0.1	5.2×10^{-4}	4.9×10^{-4}
Dolomite	HCl (0.007 M)	322.15	0.1	4.3×10^{-4}	3.8×10^{-4}
Dolomite	HCl (0.001 M)	353.15	0.1	1.2×10^{-4}	1.0×10^{-4}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	353.15	13.8	9.0×10^{-5}	6.8×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	373.15	6.0	7.7×10^{-5}	6.3×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	353.15	6.0	7.0×10^{-5}	6.0×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	333.15	6.0	6.8×10^{-5}	5.9×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	323.15	6.0	5.0×10^{-5}	4.2×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	373.15	10.0	9.4×10^{-5}	8.1×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	353.15	10.0	9.4×10^{-5}	7.1×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	333.15	10.0	7.6×10^{-5}	6.1×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	323.15	10.0	5.9×10^{-5}	5.1×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	373.15	13.8	1.2×10^{-4}	1.1×10^{-4}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	353.15	13.8	9.1×10^{-5}	7.7×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	333.15	13.8	7.1×10^{-5}	6.6×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	373.15	15.0	1.4×10^{-4}	1.1×10^{-4}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	353.15	15.0	1.1×10^{-4}	8.8×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	333.15	15.0	8.1×10^{-5}	6.4×10^{-5}
Dolomite	$\text{CO}_2 + \text{H}_2\text{O}$	323.15	15.0	6.4×10^{-5}	4.5×10^{-5}
Chalk	$\text{CO}_2 + \text{H}_2\text{O}$	353.15	6.0	7.4×10^{-4}	-
Limestone	$\text{CO}_2 + \text{H}_2\text{O}$	353.15	6.0	8.4×10^{-4}	-

Table S4. Initial dissolution rates r of magnesite in different aqueous media at temperatures T and pressures P

Mineral	Medium	T (K)	P (MPa)	r (mol·m ⁻² ·s ⁻¹)
Magnesite	HCl (8.7 x 10 ⁻⁴ M)	353.15	0.1	1.0 x 10 ⁻⁶
Magnesite	HCl (7.7 x 10 ⁻⁴ M)	344.15	0.1	5.4 x 10 ⁻⁷
Magnesite	HCl (7.9 x 10 ⁻³ M)	323.15	0.1	3.3 x 10 ⁻⁷
Magnesite	HCl (8.9 x 10 ⁻³ M)	334.15	0.1	2.6 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	373.15	5.0	1.1 x 10 ⁻⁶
Magnesite	CO ₂ + H ₂ O	353.15	5.0	6.2 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	333.15	5.0	2.4 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	323.15	5.0	1.5 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	373.15	8.0	9.9 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	353.15	8.0	6.4 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	333.15	8.0	2.9 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	323.15	8.0	1.8 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	373.15	10.0	1.0 x 10 ⁻⁶
Magnesite	CO ₂ + H ₂ O	353.15	10.0	6.8 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	333.15	10.0	2.9 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	323.15	10.0	2.0 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	373.15	13.8	1.2 x 10 ⁻⁶
Magnesite	CO ₂ + H ₂ O	353.15	13.8	6.7 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	333.15	13.8	2.9 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	323.15	13.8	2.1 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	373.15	15	1.1 x 10 ⁻⁶
Magnesite	CO ₂ + H ₂ O	353.15	15	7.1 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	333.15	15	3.0 x 10 ⁻⁷
Magnesite	CO ₂ + H ₂ O	323.15	15	2.2 x 10 ⁻⁷