

Reactive Transport Modeling and Sensitivity Analysis of CO₂–Rock–Brine Interactions at Ebeity Reservoir, West Kazakhstan

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Supporting Information

Submitted to *Sustainability*

September 2023

Section S1. Porosity Calculation

We quantitatively characterized the change in porosity resulting from mineral dissolution/precipitation using the following approach. To calculate the change in the porosity based on the molar concentration changes in the system, we used the formula:

$$Volume = Molar\ volume \times Molarity$$

We also used the formula:

$$Porosity = \frac{V_{voids}}{V_{total}} + Porosity_{initial}$$

where Porosity represents the final porosity of the material as a fraction or percentage, V_{voids} represents the ratio of the volume of void spaces (pores, fractures, etc.) within the material to the total bulk volume of the material, and $Porosity_{initial}$ is the initial porosity of the material. This calculation allows us to account for changes in the porosity due to mineral reactions.

Table S1. XRD analysis results of four samples.

Mineral name	Chemical formula	Sample 1 weight, %	Sample 2 weight, %	Sample 3 weight, %	Sample 4 weight, %	Average weight, %	Concentration [mol/kg]	Stan. deviation
<i>Primary</i>								
Quartz	SiO ₂	62.20	62.40	63.20	61.30	62.2	204.002	0.675
Albite	NaAlSi ₃ O ₈	22.10	21.50	21.20	22.10	21.6	16.183	0.389
Calcite	CaCO ₃	3.20	3.70	3.10	3.80	3.4	6.694	0.304
Kaolinite	Al ₂ Si ₂ O ₅ (OH) ₄	9.90	10.10	10.00	10.60	10.1	7.712	0.269
Magnesite	MgCO ₃	0.28	0.27	0.33	0.32	0.30	0.701	0.025
Siderite	FeCO ₃	0.72	0.66	0.65	0.72	0.70	1.191	0.032
Muscovite	KAl ₃ Si ₃ O ₁₀ (OH) ₂	1.20	0.80	1.10	0.90	1.0	0.494	0.158
Magnetite	Fe ₃ O ₄	0.30	0.25	0.38	-	0.30	0.255	0.053
<i>Secondary</i>								
Dawsonite	NaAlCO ₃ (OH) ₂	-	-	-	-	0.0	0.0	-
Ankerite	Ca(Mg,Fe)(CO ₃) ₂	-	-	-	-	0.0	0.0	-

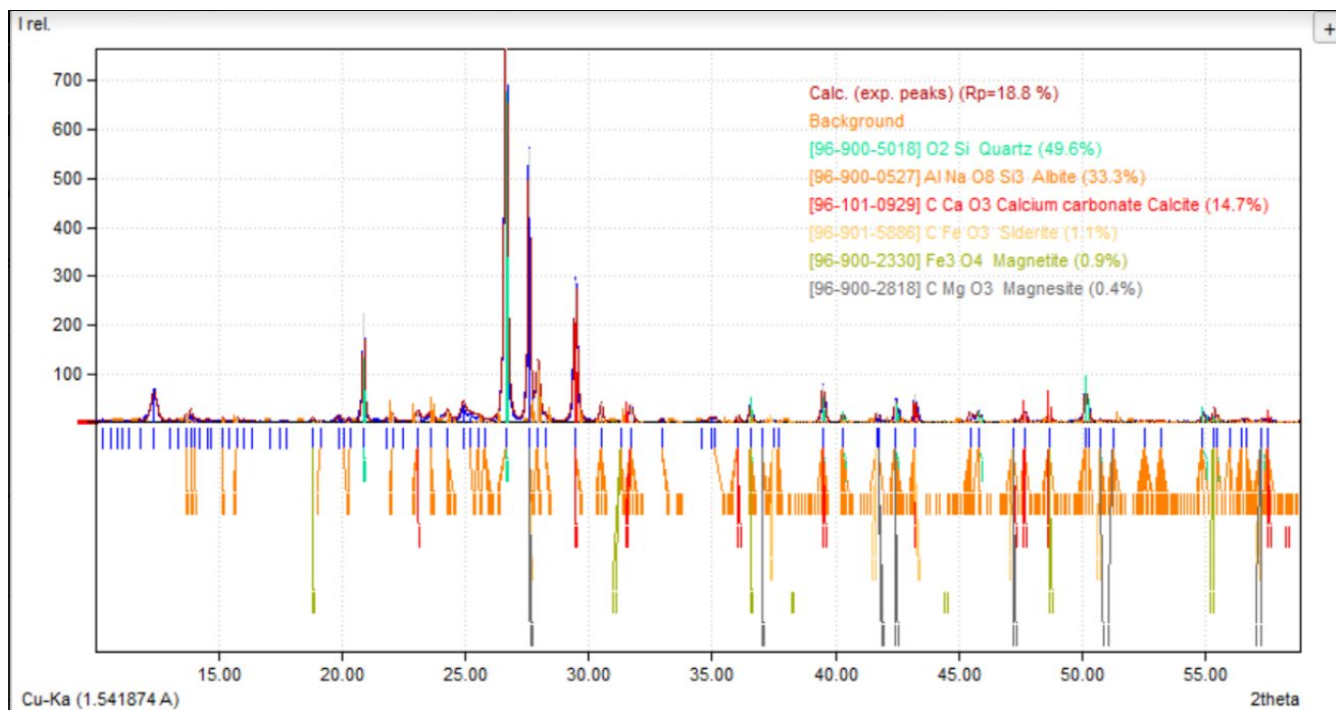


Figure S1. XRD diffractogram.

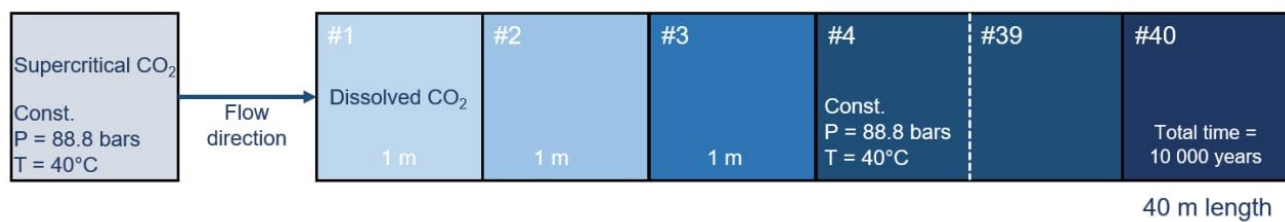


Figure S2. Conceptual representation of a model.

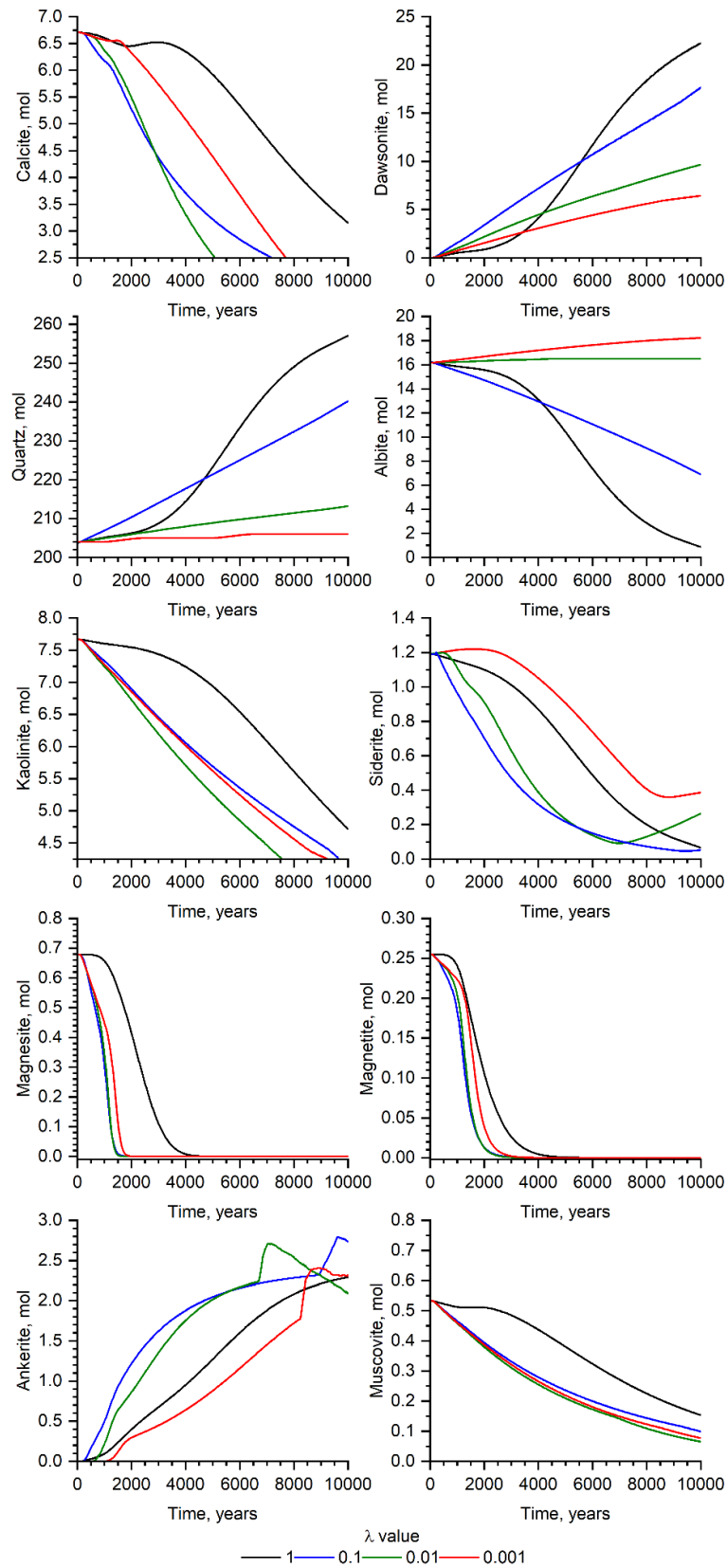


Figure S3. The effect of different reactive surface area fractions λ on mineral alterations throughout the reaction time at 20 m away from the injection point.