

SUPPLEMENTARY DATA

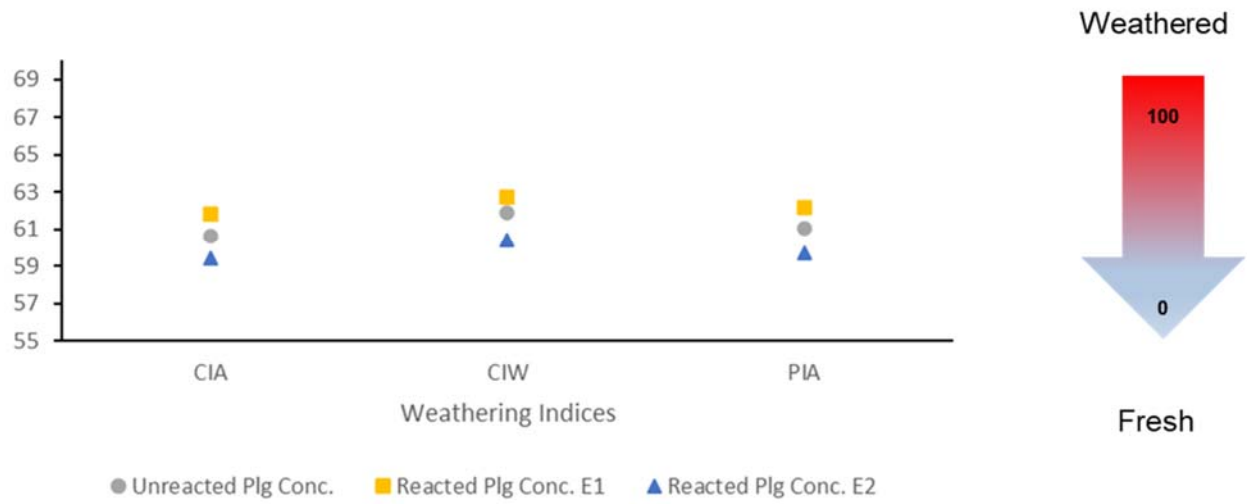


Fig. S1 Scatter plot showing several weathering indices for unreacted plagioclase concentrate, and the resultant samples after Experiments 1 and 2 for plagioclase concentrates, compared to those of pyroxene, they are more constrained/clustered close to each other. Suggesting less weathering from the reacted samples, compared to the magnesian counterparts (indices were adapted from Price and Velbel 2003)

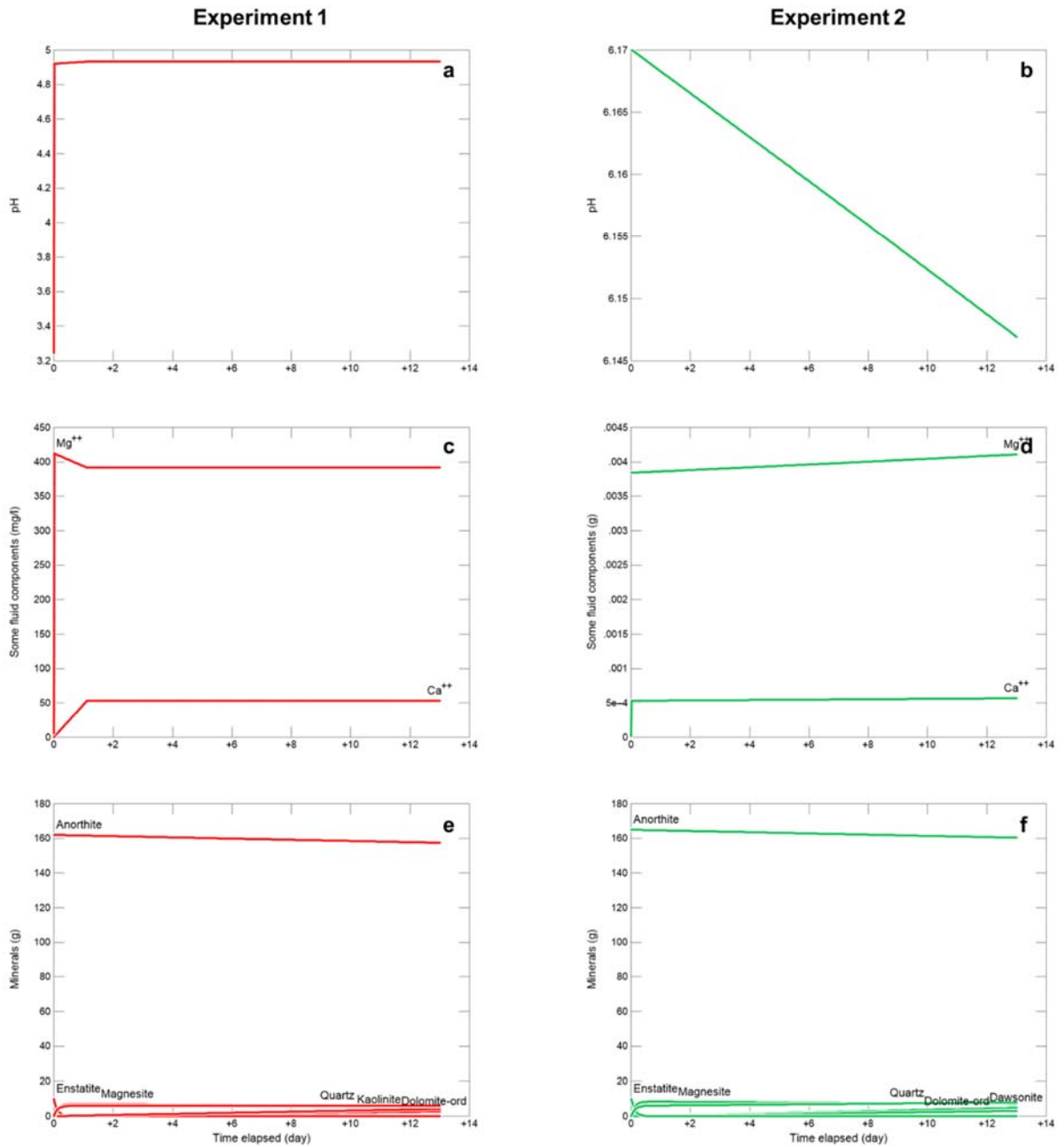


Fig. S2. The graphical outputs of the GWB model for the plagioclase concentrate reaction, with the simulated pH change of solution shown in a) and b). c) and d) indicate the evolution of Mg and Ca concentrations in the fluid over time; more specifically, the two graphs visualise the mass concentration limit in Experiment 1 and the cation depletion in Experiment 2 due to the presence of NaHCO_3 . Graphs e) and f) show mineral phase changes (in mass) over time.

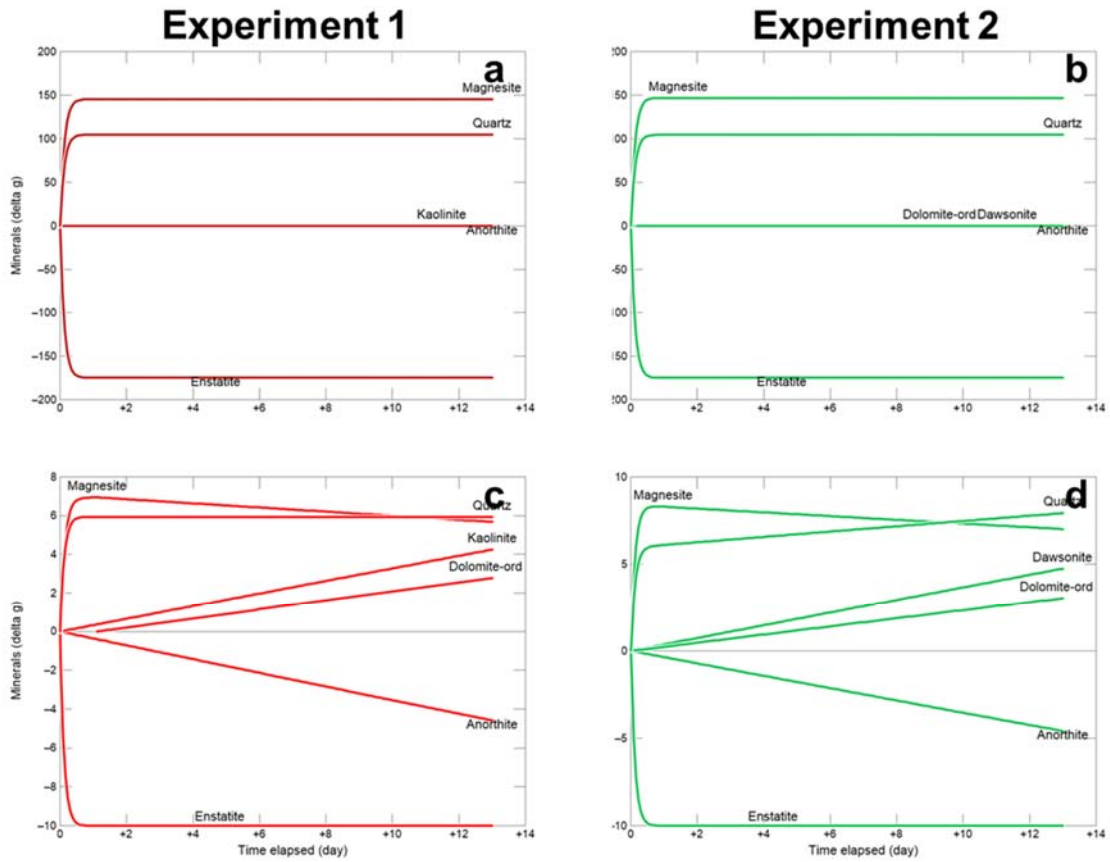


Fig. S3. The graphical outputs of the GWB model for the pyroxene (a -b)- and plagioclase (c-d) concentrate reaction, with the “Delta grams” represents the difference in mass of the mineral at a specific time compared to its initial mass. A positive delta mass indicates an increase in mass (mineral precipitation), while a negative delta mass signifies a decrease in mass (mineral dissolution).

React Input: Experiment 1 (Table 2) – Pyroxene Concentrate:

```
# React script, saved Wed Dec 4 2024 by zakhe
data = thermo.tdat verify
conductivity = conductivity-USGS.dat
time start = 0 day, end = 13 day
temperature = 100 C
H2O          = 1 free kg
swap CO2(aq) for H+
CO2(aq)      = .6431 molal
Ca++         = .01 mg/kg
Mg++         = 5.05 mg/kg
Cl-          = 1 molal
balance on Cl-
Na+          = 1 molal
K+           = 7.15 mg/kg
SiO2(aq)     = .01 mg/kg
Al+++        = .01 mg/kg
HCO3-        = .01 mg/kg
kinetic Enstatite 175 g pre-exp = .00024 act_eng = 48500 surface = 25400
fix activity of CO2(aq)
kinetic Anorthite 10 g rate_con = 3.55e-15 surface = 25400
```

GWB React Input: Experiment 2 (Table 2) – Pyroxene Concentrate:

```
# React script, saved Wed Dec 4 2024 by zakhe
data = thermo.tdat verify
conductivity = conductivity-USGS.dat
time start = 0 day, end = 13 day
temperature = 100 C
H2O          = 1 free kg
swap CO2(aq) for H+
CO2(aq)      = .6431 molal
Ca++         = .01 mg/kg
Mg++         = 5.05 mg/kg
Cl-          = 1 molal
balance on Cl-
Na+          = 1.64 molal
K+           = 7.15 mg/kg
SiO2(aq)     = .01 mg/kg
Al+++        = .01 mg/kg
HCO3-        = .64 molal
kinetic Enstatite 175 g pre-exp = .00024 act_eng = 48500 surface = 25400
fix activity of CO2(aq)
kinetic Anorthite 10 g rate_con = 3.55e-15 surface = 25400
```

GWB React Input: Experiment 1 – Plagioclase Concentrate:

```
# React script, saved Wed Dec 4 2024 by zakhe
data = thermo.tdat verify
conductivity = conductivity-USGS.dat
time start = 0 day, end = 13 day
temperature = 100 C
H2O          = 1 free kg
swap CO2(aq) for H+
CO2(aq)      = .6431 molal
Ca++         = .01 mg/kg
Mg++         = 5.05 mg/kg
Cl-          = 1 molal
balance on Cl-
Na+          = 1 molal
K+           = 7.15 mg/kg
SiO2(aq)     = .01 mg/kg
Al+++        = .01 mg/kg
HCO3-        = .01 mg/kg
kinetic Enstatite 10 g pre-exp = .00024 act_eng = 48500 surface = 25400
fix activity of CO2(aq)
kinetic Anorthite 165 g rate_con = 3.55e-15 surface = 25400
```

GWB React Input: Experiment 2 – Plagioclase Concentrate:

```
# React script, saved Fri Dec 6 2024 by zakhe
data = thermo.tdat verify
conductivity = conductivity-USGS.dat
time start = 0 day, end = 13 day
temperature = 100 C
H2O          = 1 free kg
swap CO2(aq) for H+
CO2(aq)      = .6431 molal
Ca++         = .01 mg/kg
Mg++         = 5.05 mg/kg
Cl-          = 1 molal
balance on Cl-
Na+          = 1.64 molal
K+           = 7.15 mg/kg
SiO2(aq)     = .01 mg/kg
Al+++        = .01 mg/kg
HCO3-        = .64 molal
kinetic Enstatite 10 g pre-exp = .00024 act_eng = 48500 surface = 25400
fix activity of CO2(aq)
kinetic Anorthite 165 g rate_con = 3.55e-15 surface = 25400
```

Please note: Output files included as part of supplementary data (zipped folder).