

Typical reactions in the chemical weathering of silicate rocks

The table below shows some representative reactions for weathering of silicate minerals in Bowen's Reaction Series and thus in igneous rocks. For the weathering of feldspars, the table shows kaolinite as the Al-bearing product; the list would be more complete if it also included smectite-producing

and gibbsite-producing reactions representative of drier and wetter climates, respectively, than those in which kaolinite forms. The list would be more thorough if the reactions for Fe-bearing minerals didn't stop with Fe²⁺ as a product but showed Fe²⁺ then oxidized to an Fe³⁺-bearing solid.

One point of this list is the column at right, which shows that weathering of all these minerals other than quartz produces bicarbonate (HCO₃⁻) as a solute, and that minerals higher in Bowen's Reaction Series are increasing prolific in producing bicarbonate as they weather.

Mineral	Weathering Reaction	HCO ₃ ⁻ /H ₄ SiO ₄
Olivine	$4\text{H}_2\text{CO}_3 + \text{MgFeSiO}_4 \rightarrow \text{Mg}^{2+} + \text{Fe}^{2+} + 4\text{HCO}_3^- + \text{H}_4\text{SiO}_{4(\text{aq})}$	4:1
Pyroxene	$4\text{H}_2\text{CO}_3 + 2\text{H}_2\text{O} + \text{MgFe}(\text{SiO}_3)_2 \rightarrow \text{Mg}^{2+} + \text{Fe}^{2+} + 4\text{HCO}_3^- + 2\text{H}_4\text{SiO}_{4(\text{aq})}$	2:1
Amphibole	$14\text{H}_2\text{CO}_3 + 8\text{H}_2\text{O} + (\text{MgFe})_7\text{Si}_8\text{O}_{22}(\text{OH})_2 \rightarrow 7(\text{Mg,Fe})^{2+} + 14\text{HCO}_3^- + 8\text{H}_4\text{SiO}_{4(\text{aq})}$	1.75:1
Anorthite	$2\text{H}_2\text{CO}_3 + 2\text{CaAl}_2\text{Si}_2\text{O}_8 + \text{H}_2\text{O} \rightarrow 2\text{Ca}^{2+} + 2\text{HCO}_3^- + \text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_{4(\text{s})}$	∞
Plagioclase (An ₅₀)	$6\text{H}_2\text{CO}_3 + 2\text{CaNaAl}_3\text{Si}_5\text{O}_{16} + 11\text{H}_2\text{O} \rightarrow 2\text{Ca}^{2+} + 2\text{Na}^+ + 6\text{HCO}_3^- + 3\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_{4(\text{s})} + 4\text{H}_4\text{SiO}_{4(\text{aq})}$	1.5:1
K Feldspar	$2\text{H}_2\text{CO}_3 + 2\text{KAlSi}_3\text{O}_8 + 9\text{H}_2\text{O} \rightarrow 2\text{K}^+ + 2\text{HCO}_3^- + \text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_{4(\text{s})} + 4\text{H}_4\text{SiO}_{4(\text{aq})}$	1:2
Quartz	$\text{SiO}_{2(\text{s})} + 2\text{H}_2\text{O} \rightarrow \text{H}_4\text{SiO}_{4(\text{aq})}$	0:1