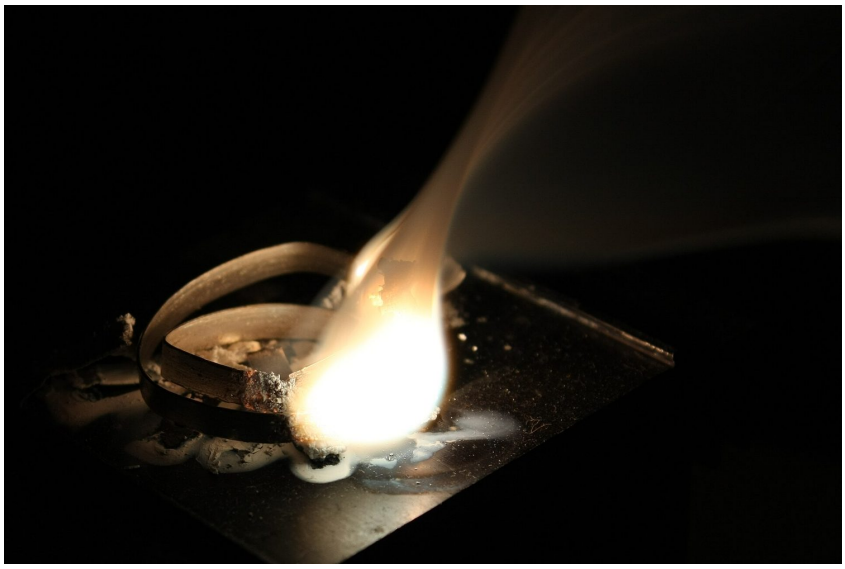
Group 2

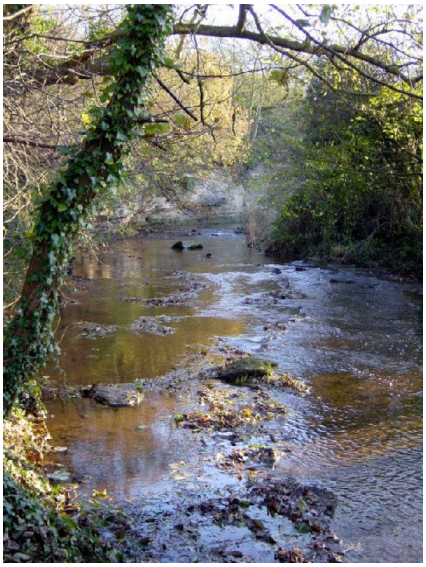
A-Level Chemistry

The Group 2 metals



Magnesium, a Group 2 metal, burns with a brilliant white flame.

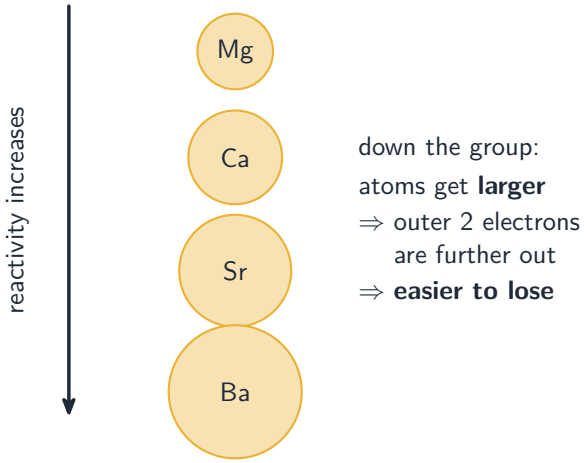
Image: Capt. John Yossarian, CC BY-SA 3.0 (commons.wikimedia.org)



Limestone is calcium carbonate —a compound of the Group 2 metal calcium.

Image: Heather Holdridge, CC BY-SA 2.0 (commons.wikimedia.org)

Group 族 2 holds the metals magnesium, calcium, strontium and barium. They all have two outer electrons, which they lose to form 2+ ions. Going **down** the group, the atoms get larger and the outer electrons are easier to lose, so the metals get **more reactive** — their **reactivity** 反应活性 increases down the group.



Reactivity increases down Group 2: larger atoms hold their two outer electrons less tightly, so they are lost more easily

Reactions of the elements

With **oxygen**, they burn to form an oxide:

$$2\mathrm{Mg} + \mathrm{O_2} \rightarrow 2\mathrm{MgO}$$

Magnesium burns in air with a brilliant white flame, forming white magnesium oxide

With **water**, they form a hydroxide and hydrogen. The reaction gets faster down the group:

$$\mathrm{Ca} + 2\mathrm{H_2O} \rightarrow \mathrm{Ca(OH)_2} + \mathrm{H_2}$$

Magnesium is slow with cold water but reacts fast with steam, giving MgO and $\mathrm{H_2}$.

With **dilute hydrochloric or sulfuric acid**, they form a salt and hydrogen:

$$Mg + 2HCl \rightarrow MgCl_2 + H_2 \qquad Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$$

With sulfuric acid the reaction slows down the group, because the **sulfates** 硫酸盐 formed (such as $BaSO_4$) are insoluble and coat the metal.

Reactions of the compounds

The **oxides** 氧化物 and **hydroxides** 氢氧化物 are basic. They react with water and with dilute acids:

$$MgO + H_2O \rightarrow Mg(OH)_2 \qquad Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$$

The **carbonates** 碳酸盐 react with dilute acids to give a salt, water and carbon dioxide:

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

Thermal decomposition

Thermal decomposition 热分解 means breaking a compound apart by heating it.

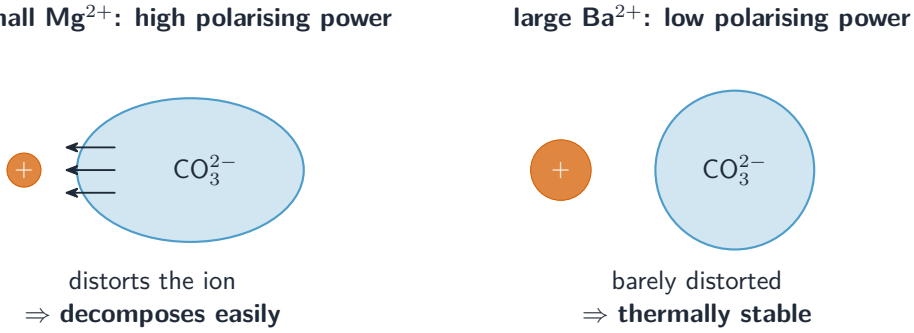
- the carbonates break into the oxide and carbon dioxide:

$$CaCO_3 \rightarrow CaO + CO_2$$

- the **nitrates** 硝酸盐 break into the oxide, brown nitrogen dioxide gas and oxygen:

$$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$$

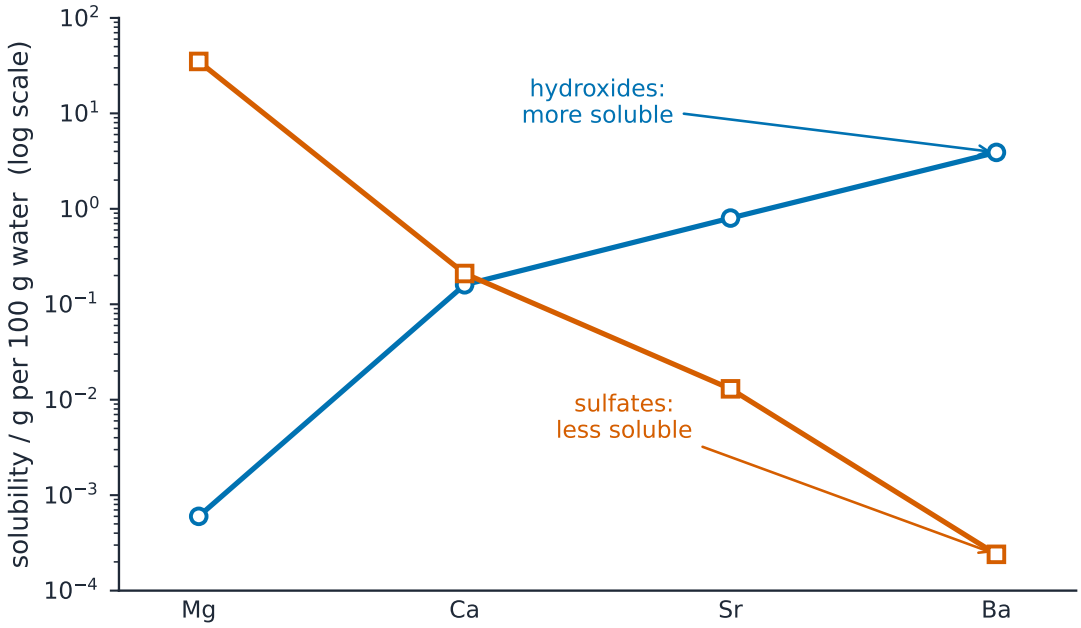
The **thermal stability** 热稳定性 of both the carbonates and the nitrates **increases** down the group. A larger metal ion pulls less on the carbonate or nitrate ion, so the compound is harder to break apart —it needs a higher temperature. So magnesium carbonate decomposes most easily, and barium carbonate is the hardest.



Thermal stability rises down the group: a small cation polarises (distorts) the carbonate ion more, weakening it so it decomposes more easily

Trends in solubility

Compound	Trend in solubility 溶解度 down the group
hydroxides	**increase** ($Mg(OH)_2$ almost insoluble; $Ba(OH)_2$ soluble)
sulfates	**decrease** ($MgSO_4$ soluble; $BaSO_4$ insoluble)



Down Group 2 the hydroxides become more soluble while the sulfates become less soluble (note the log scale)

From these trends you can predict the properties of the next element down, radium, and of its compounds.