Compositional analysis of minerals by TGA

INTRODUCTION

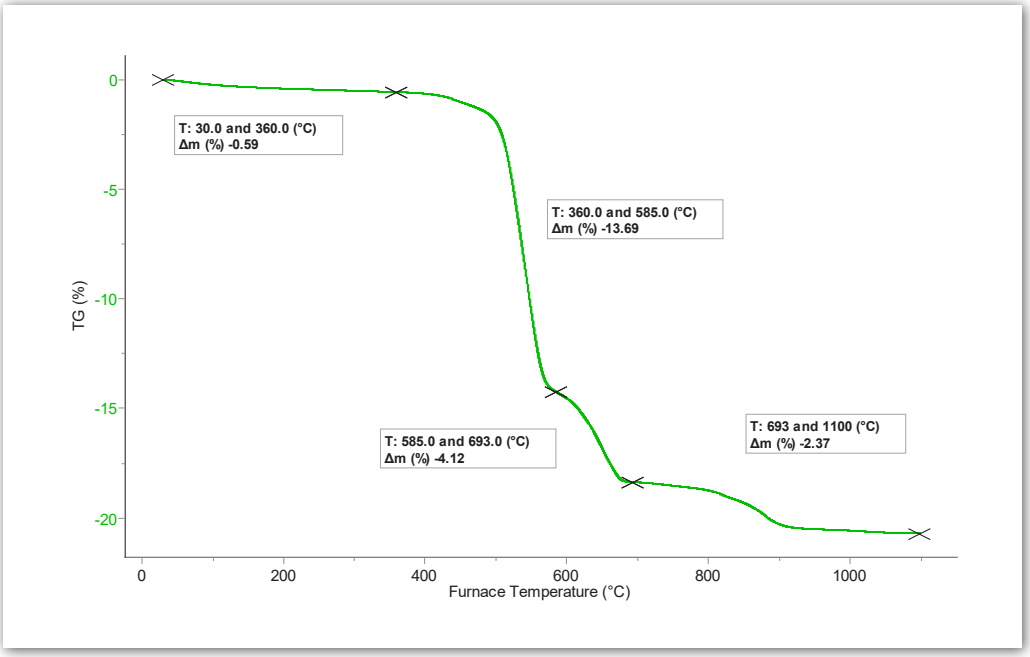
Compositional analysis of rocks, sands, ores or other minerals helps with the determination of their value or their best application. It can also identify components that can affect the end products' processing or marketability. Minerals can be complex mixtures of many components such as dolomite, magnesite, talc etc… TGA allows for the characterization of the minerals' compositions through their mass variation during heating, when different reactions like dehydration, dehydroxylation, or thermal dissociation occur.

EXPERIMENT

Compositional analysis of a mineral powder was performed using SETLINE TGA. A small quantity (20 mg) of a mineral powder was inserted into a platinum crucible and the following thermal profile was applied on the sample:

- Heating from 30°C up to 1100°C at 5°C/min
- Under a 30ml/min nitrogen flow rate

RESULTS AND CONCLUSION



For the investigated mineral sample, the following results were obtained:

1. from 30°C to 360°C, emission of volatile compounds: 0.59%

2. from 360°C to 585°C, a mass loss due to the dissociation of Magnetite:

$$MgCO_3 \rightarrow MgO + CO_2$$

3. from 585°C to 693°C, a mass loss due to the two-steps decomposition of Dolomite. The steps appear as one mass loss as they occur at almost identical temperatures:

$$CaMg(CO_3)_2 \rightarrow CaCO_3 + MgO + CO_2 \quad \text{then} \quad CaCO_3 \rightarrow CaO + CO_2$$

4. from 693°C to 1100°C, a mass loss due to the decomposition of Talc:

$$Mg_3Si_4O_{10}(OH)_2 \rightarrow 3MgSiO_3 + SiO_2 + H_2O$$

For each reaction, a stoichiometric factor is determined, by the following equation:

$$f = \frac{Mm}{\sum Mp}$$

Where Mm = molar mass of the mineral

Mp = molar mass of the volatiles compounds emitted during the reaction(s)

Each component's content is then calculated based on the mass loss and this stoichiometric factor following the equation:

$$C = f \times m$$

Where C = Component content in %

f = Stoichiometric factor

m = mass loss during the reaction in %

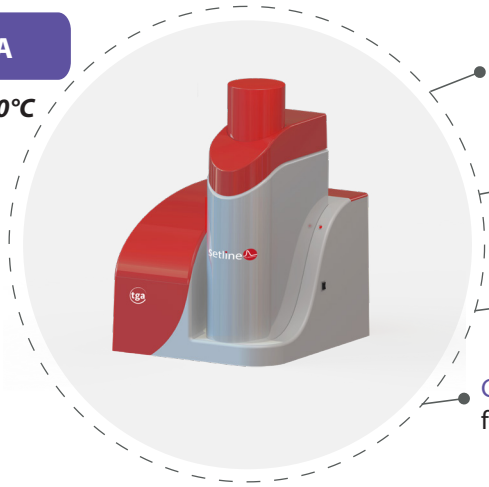
Step	Component reacting	Mass loss	Stoichiometric factor	Component content
2	Magnesite, $MgCO_3$	13.69%	1.92	26% of magnesite
3	Dolomite, $CaMg(CO_3)_2$	4.12%	2.1	9% of dolomite
4	Talc, $Mg_3Si_4O_{10}(OH)_2$	2.37%	21.05	50% of talc

The results obtained show that Setline TGA is very well adapted for the investigation of minerals materials and especially for their compositional analyses.

INSTRUMENT

SETLINE TGA

Ambient to 1100°C



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