Capture and storage of carbon dioxide in minerals

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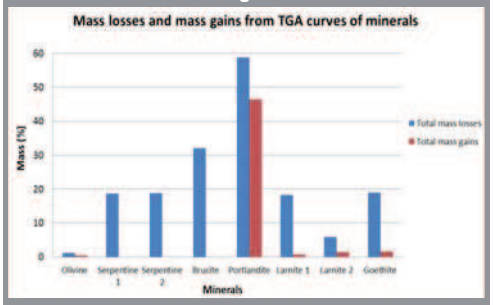
Introduction

Since carbon dioxide is the main greenhouse gas in the natural state, methods to control this gas are studied in the field of research. A study was conducted by researchers about the capture and the storage of carbon dioxide in minerals.
Thermogravimetric analysis is used to measure the evolution of the mass of a sample depending on the temperature, under a specific atmosphere at a fixed heating rate. Thus, the carbonation of various minerals using carbon dioxide as a reactive gas was conducted by TGA. The aim was to study the possible mass gain of these samples in atmospheric pressure.

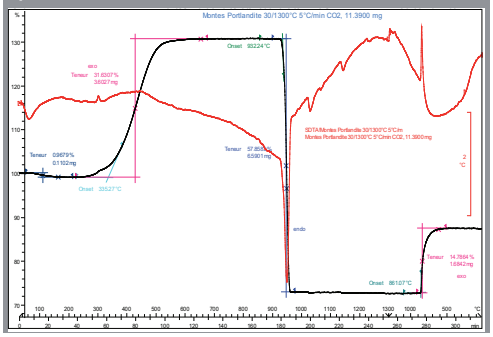
Experimental conditions

Various minerals, such as olivine, serpentine, brucite, portlandite, larnite and goethite, were tested to study the presence of carbonation. Analyses were performed on a Mettler Toledo thermobalance (TGA / SDTA 851). The experimental conditions included an increase in temperature from 30 to 1300°C, with a carbon dioxide flow of 50 mL/min and a heating rate of 10°C/min. The crucible used was made of aluminium, its volume was 150 µL and the mass of samples was collected from about 11 mg.
TGA curves for different minerals were exploited by the first derivative TGA signal and the SDTA curve (signal of differential thermal analysis) which were used to highlight the losses or the gains of mass for the first and the exothermic or endothermic phenomena for the second.

Graph 1 : Mass losses and mass gains for minerals obtained through the TGA curves



Graph 2 : TGA (black) and SDTA (red) curves of portlandite



Results and discussion

According to the different curves obtained for the eight minerals, it was possible to conclude that they all lost mass with a variable percentage (graph 1). However, some samples, such as portlandite, olivine, larnite and goethite, gained mass, so they were carbonated. The sample of portlandite gave the best result with carbonation, that is to say the mass gain was more or less 30%. This phenomenon started around 330°C and ended after 600°C (graph 2). Decarbonation, which was endothermic, took place at temperatures above 900°C. The percentage of mass losses was higher to mass gains because the sample also contained calcite which always releases CO_2 around 900°C. It was interesting to note that the sample underwent another carbonation during cooling at a rate of 20 ° C/min, with a mass gain of about 15%.

Conclusion

These first results of carbonation by TGA under CO_2 are promising and analyses at different isothermal temperatures remain to do to complete the study.

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