

**In-situ measurements of solid-gas carbonation of calcium hydroxide using an infrared microscope coupled to an environmental reaction cell. Implications on the carbonate formation in Martian aerosols.** G. Montes-Hernandez<sup>1, 2</sup>, A. Pommerol<sup>2</sup>, F. Renard<sup>1, 3</sup>, P. Beck<sup>2</sup>, E. Quirico<sup>2</sup>, O. Brissaud<sup>2</sup>. <sup>1</sup>University Joseph Fourier, Laboratoire de Géodynamique des Chaînes Alpines, OSUG-CNRS, BP 53, 38042 Grenoble Cedex 9, France. <sup>2</sup>University Joseph Fourier, Laboratoire de Planétologie de Grenoble, OSUG-CNRS/INSU, BP 53, 38041 Grenoble Cedex 9, France. <sup>3</sup>Physics of Geological Processes, University of Oslo, Norway

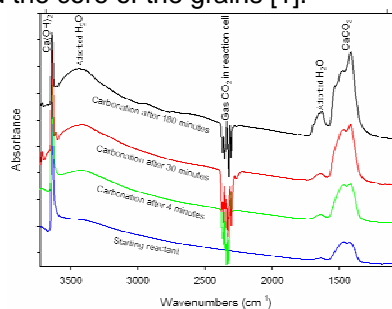
### Abstract

Carbonate minerals can be formed via aqueous or via solid-gas carbonation routes in natural environments. For the solid-gas carbonation route, the adsorbed water can catalyse the reaction at low temperature. The in-situ measurements using an infrared microscope coupled to a solid-gas reaction cell revealed that slight amount of adsorbed water (free molecular water) on the calcium hydroxide particles is enough to activate the solid-gas carbonation at low temperature (<35°C) and low CO<sub>2</sub> pressure (<1bar). Then it is rapidly autocatalysed by the water production up to the formation of a dense nonporous layer of carbonate around the core of the grains (Figure 1). Conversely, the solid-gas carbonation of calcium hydroxide particles without adsorbed water “dry route”, water removed from system by vacuum drying (10<sup>-5</sup> mbar and 105 °C), is not detectable a low temperature. This was slightly detected at 300°C and low CO<sub>2</sub> pressure (<1bar). For this case, the atomic excitation due to high temperature allows the migration of oxygen atoms from the solid towards adsorbed CO<sub>2</sub>, producing its mineralization in carbonate around the core of the grains [1].

silicates (Li<sub>2</sub>SiO<sub>3</sub>, Na<sub>2</sub>SiO<sub>3</sub>, CaSiO<sub>3</sub>, MgSiO<sub>3</sub> or solid solutions) by taking into account the influence of adsorbed water content, the CO<sub>2</sub> pressure (<1bar), temperature (<35°C) and ultraviolet radiation is an important challenge for future studies in our laboratory. For example, these investigations may help to understand and demonstrate the carbonates formation in water unsaturated environments (ex. Martian aerosols) at the current atmospheric conditions.

[1] Montes-Hernandez et al. (2009) In-situ measurements of solid-gas carbonation of calcium hydroxide using an infrared microscope coupled to an environmental reaction cell (submitted).

Corresponding author:  
[german.montes-hernandez@obs.ujf-grenoble.fr](mailto:german.montes-hernandez@obs.ujf-grenoble.fr)



*Figure 1. In-situ measurements of solid-gas carbonation of portlandite (Ca(OH)<sub>2</sub>) in presence of slight amount of adsorbed water (free molecular water) and at low temperature (25°C) using an infrared microscope coupled with an environmental reaction cell. The infrared measurements were performed with a BRUKER HYPERION 3000 microscope in transmission mode, with a MCT mono-detector at 4 cm<sup>-1</sup> resolution for 100 scans. The typical size of the infrared spot onto the sample was ~ 50x50 μm<sup>2</sup>.*

Measuring the solid-gas carbonation kinetics for several hydroxides, hydroxide-solid nanocomposites and alkaline metastable