CHARACTERIZATION OF WATER DISTRIBUTION IN GEO-MATERIALS AND THEIR THERMO-REACTIVITY BY USING INFRARED MICROSCOPY COUPLED TO A VACUUM-TEMPERATURE DRYING CELL. G. Montes-Hernandez[1, 2], A. Pommerol[2], E. Quirico[2], P. Beck[2], O. Brissaud[2], F. Renard[1, 3]. [1]University Joseph Fourier, Laboratoire de Géodynamique des Chaînes Alpines, OSUG-CNRS-INSU, BP 53, 38042 Grenoble Cedex 9, France. [2]University Joseph Fourier, Laboratoire de Planétologie de Grenoble, OSUG-CNRS-INSU, BP 53, 38041 Grenoble Cedex 9, France. [3]Physics of Geological Processes, University of Oslo, Norway

Abstract: The qualitative/quantitative characterization of the water distribution in solids (molecular water "H_2O" and hydroxide ions "OH") gives an important information on the aqueous mineral alteration (e.g. olivine and pyroxene hydrolysis), on the physicochemical nature of solids (e.g. hydrophilic or hydrophobic properties, mineral composition and nature of interlayer or charge-compensator cations) and on the solid textural properties (e.g. external surface area, grain particle size and porosity). In the present study, we propose a novel method to characterize the water distribution in inorganic solids (terrestrial or extraterrestrial origin) by using an infrared microscope coupled to a vacuum-temperature drying cell. Compared with classic infrared measurements, the present method offers various advantages; for example, the in-situ drying of solids at the grain/aggregate scale can be performed, controlling the vacuum pressure (until 10^{-5} mbar) and temperature (from 25 to 300°C). Herein, the water desorption as a function of temperature can be measured, allowing a clear differentiation between molecular water (H_2O) and hydroxide ions (OH) in inorganic solids. For this study, 8 geo-materials (*synthetic minerals:* calcite, portlandite, ferrihydrite and carbonate/iron oxide/montmorillonite composite; *natural minerals:* gypsum, Wyoming bentonite, chrysotile and Fe-Cronstedtite) were preliminary investigated. Moreover, the thermo-reactivity of fragile minerals can be also studied. For example, in this study, the decomposition of iron carbonate (siderite type) contained on a hematite/montmorillonite composite (Fig. 1(a)), the dehydration of natural gypsum and its respective hydration at the room relative humidity (Fig. 1(b)) and the dehydration of synthetic ferrihydrite are reported.

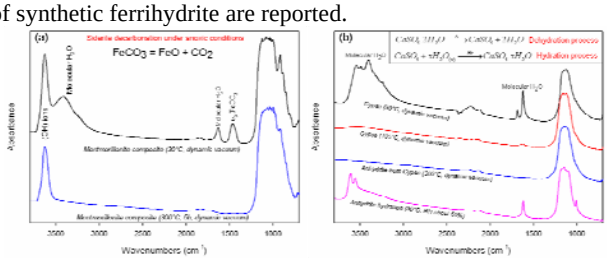

Figure 1. (a) Siderite d carbonation under anoxic conditions and; dry and moist state of a montmorillonte composite. (b) complete dehydration of gypsum and re-hydration of respective calcium sulphate at room relative humidity (≈60%). The infrared measurements were performed with a BRUKER HYPERION 3000 microscope in transmission mode, with a MCT mono-detector at 4 cm^{-1} resolution for 320 scans. The typical size of the infrared spot onto the sample was ~ 50x50 µm^2.

Measuring the water distribution in most complex solids (ex. extraterrestrial objects), in particular hydroxide ions in chondrites materials is an important challenge for near future studies in our laboratory. For example, these investigations may help to understand the chemical alteration processes into these complex materials.

Corresponding author: german_montes@hotmail.com