Advanced InfraRed and Raman spectroscopy on Ca-phosphates and Mg-carbonates for surface exploration of Mars

A. FAU[1], O. BEYSSAC[1], M. GAUTHIER[1], S. BERNARD[1], K. BENZERARA[1], P.Y. MESLIN[2], C.DROUET[3], S. MAURICE[2], F. GUYOT[1], E. BALAN[1]

[1] IMPMC, UPMC, Sorbonne Universités, CNRS, MNHN, IRD, 75005 Paris, France – Amaury.Fau@impmc.upmc.fr
[2] IRAP, CNRS-OMP Toulouse, France
[3] CIRIMAT Toulouse, France

Raman spectroscopy is an increasingly popular technique for *in-situ* exploration of planetary surfaces like Mars. Two missions already planned to send a Raman spectrometer on Mars. While the ESA ExoMars rover will be equipped with a continuous wave (CW) micro-Raman spectrometer, the payload of the NASA Mars2020 rover will comprise the SuperCam instrument, a remote time-resolved (TR) Raman spectrometer combined with a laser-induced-breakdown spectrometer (LIBS) and a passive infrared (IR) spectrometer.

Carbonates and phosphates have been detected at the surface of Mars and may be the principal mineral carriers for elements C and P on this planet. In addition to potentially constitute important tracers of surface geological processes, such as hydrothermalism or irradiation, they may carry invaluable information about a putative past Martian biogenic activity. Here, we report the Raman and IR characterization of a variety of synthetic and natural hydroxy- and fluoro-apatites, as well as on a collection of Mg-carbonates including hydrated phases. These analyses were done by combining conventional CW Raman spectroscopy at various wavelengths with TR Raman spectroscopy, and conventional attenuated total reflextance and/or transmission IR spectroscopy in the mid IR region with diffuse reflectance measurements in the near IR.

The sensitivity of the different Raman and IR configurations to the structure and chemistry of these minerals is tested and compared. Using TR Raman spectroscopy, mineral luminescence for some of these phases will be analyzed to trace the presence of mineral impurities (such as trace elements, organics …). Importantly, an effective protocol will be presented to extract the Raman signals from the luminescence background. Altogether, the chemical and structural informations that can be retrieved in the laboratory or using rover instruments for such minerals is rich and will be discussed.