QUANTITATIVE STUDY OF THE 10 µm SILICATE BAND IN INTERPLANETARY DUST PARTICLES.

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Introduction: Interplanetary Dust Particles (IDPs) are particles originating from an asteroidal or cometary parent body. Their mineralogical composition can give clues on their parent bodies' characteristics and thus on the formation of the solar system [1].

In this study we analyze a few IDPs of the NASA collection with complementary analytical techniques (Infrared (IR) micro-spectroscopy, Raman spectroscopy and SEM-EDX analyses) to get information on their mineralogy, their organics and their elementary composition.

Experiment: The studied IDPs were crushed into a Diamond'EXPress compression cell following the protocol of [2], [3]. IR micro-spectroscopy from mid to far (2.5-100 µm) infrared is performed on the SMIS2 beamline of the SOLEIL synchrotron (France) using a NicPlan microscope attached to a Fourier Transform infrared spectrometer (FTIR). Raman spectra were acquired at SOLEIL with a spectrometer DXR from Thermo Fisher with a 532 nm laser and SEM-EDX analyses were performed with a SEM Hitachi 3600N and an EDX spectrometer ThermoNoran System SIX at "l'Institut d'Electronique Fondamentale" (IEF, Orsay, France).

Procedure: The present work focuses on the mineralogical composition of the grains, and more particularly on the silicate signature, given in IR by the 10 µm feature, corresponding to the well-known stretching mode of the Si-O bonds. We are developing an analytical procedure consisting on a "deconvolution" of this band in order to quantify its different contributors (olivine, pyroxene, as well as other possible species, either crystalline or amorphous). These contributors are identified by combining the obtained results with the different analytical techniques (IR, Raman and SEM-EDX).

Silicate-type spectra were first acquired for standard minerals (olivine, pyroxene). We used crystalline minerals crushed in a diamond cell (as the same manner as the IDPs) and amorphous thin films synthesized by electron beam evaporation from the crystalline silicates [4] on a KBr or CsI substrate. Using a linear combination of the standard spectra (amorphous and crystalline), we are able to fit the 10 µm band of the IDPs.

We will present the first results obtained on the validation of our analytical procedure on synthetic samples and its application on IDPs. This work is still under improvement but this technique seems promising to infer the quantitative mineralogical composition of IDPs and thus give clues on the processes undergone by their parent bodies.

References: [1] Sandford S.A., and Bradley J.P. 1989, Icarus. 82. p. 146-166. [2] Grossemy. F. 2008 PhD Thesis, France. [3] Brunetto R. et al. 2011. Icarus. 212. p. 896-910. [4] Djouadi Z. et al. 2005. Astronomy & Astrophysics. 440. p. 179-184.