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Nanoscale mineralogy and organic structure in carbonaceous chondrites studied with AFM-IR spectroscopy

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Meteorite matrices from primitive chondrites are an interplay of ingredients at the sub-µm scale, which requires analytical techniques with the nanometer spatial resolution to understand the composition of individual components in their petrographic context. Infrared spectroscopy is an effective method that enables to probe of vibrations at the molecule-atomic scale of organic and inorganic compounds but is often limited to a few micrometers in spatial resolution. To overcome the diffraction limit, here we apply Nano-IR spectroscopy (AFM-IR), based on the combination of infrared spectroscopy and atomic force microscopy to efficiently distinguish spectral signatures of the different constituents [1-2].

Our objectives are to characterize two chosen meteorite samples and their insoluble organic matter (IOM) to investigate primitive material in terms of bulk chemistry (the CI chondrite Orgueil) and organic composition (the CR chondrite EET 92042). We confirm that this technique allows to: unmix the IR signatures of the phyllosilicate from that of other matrix constituents and organic matter for the first time in Orgueil; observe the changes of structure in macromolecular hydrocarbon under the chemical extraction; provide evidence of hydrated amorphous silicates present in the early solar system on the CR chondrite EET 92042; detect the carbonate crystal structure both in CR and CI chondrites; and observe the sulfate signature in Orgueil (CI) similar to the mixture of basanite and epsomite [3]. The present work clearly shows that AFM-IR is a useful technique and suitable for Ryugu asteroid samples as well as interplanetary dust particles and other primitive solar system materials. Details results and discussions so far will be presented at the conference.

References: [1] Dazzi A. et al. (2017) *Chem Rev*. doi:10.1021/acs.chemrev.6b00448. [2]. Mathurin J, (2019). *Astron Astrophys*. [3]. Phan V. T.H. et al. (2022) *Meteorit Planet Sci*.. doi:10.1111/maps.13773