µ-FTIR, µ-RAMAN SPECTROSCOPIES AND SEM-EDX ANALYSES OF GRAINS OF THE PARIS METEORITE.

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Introduction: We investigated a few fragments from the Paris meteorite through mid- and far-infrared micro-spectroscopy (2.5 to 100 µm), Raman spectroscopy and SEM-EDX analyses to get information on their mineralogy and composition (organics and elementary). These data allow us to compare Paris (at least these fragments if representative of the meteorite) with other carbonaceous chondrites in particular, and, more generally, with other primitive extraterrestrial objects present in our collections (e.g. IDPs for Interplanetary Dust Particles).

Experiments: Few micron-sized fragments among the 13 mg received from the MNHN (Paris, France) were crushed into a Diamond compression cell [1]. Infrared spectra were obtained on the SMIS2 beamline of the SOLEIL synchrotron (France) with a NicPlan microscope attached to a Fourier Transform infrared spectrometer (FTIR). Raman spectra were acquired with a spectrometer DXR from Thermo Fisher with a 532 nm laser and EDX analyses were performed with a SEM Hitachi 3600N and an EDX spectrometer ThermoNoran System SIX at IEF (Orsay, France).

Results and Discussion: *Mineralogy* Infrared spectra are dominated by phyllosilicates and carbonates, implying a significant aqueous alteration, most probably on the parent body. Far-infrared and Raman spectra reveal the presence of magnetite and traces of sulfides, possibly troilite. Only one inclusion of crystalline anhydrous silicate (mixture of magnesium-rich olivine and pyroxene) was found in the analyzed fragments.

Organic matter The study by IR spectroscopy of the aliphatic organic matter present in the meteorite leads to a CH_2/CH_3 ratio of 2.3 ± 0.2, which is in good agreement with the reported values in Orgueil (CI) and Murchison (CM) [2]. The aromatic carbon (detected by Raman spectroscopy) has a quite ordered structure indicating that these grains have suffered a weak thermal alteration and seem to be less primitive than IDPs [3].

Elementary composition Some elementary ratios were extracted from the EDX data analyses. The obtained values Mg/Si = 0.88, Fe/Si = 0.95, S/Si = 0.42, Al/Si = 0.091, compatible with the chondritic values reported by Anders and Grevesse [4], in the range of CI and CM elementary ratios [5], [6]. However, Ni/Si = 0.078 and Ca/Si = 0.25 are higher than for the CI and CM chondrites. Our analytical techniques show an excellent correlation between the spatial distribution of the carbonates (found by IR spectroscopy) and element Ca (as shown by EDX mapping) implying that major part of the Ca is incorporated in the carbonates.

Conclusion: The combination of different analytical techniques enables both qualitative and quantitative studies of the samples. Micro spectroscopy is also a useful tool to determine the distribution of the different components in micron-sized grains.

The different analyses of the few fragments indicate that they have undergone a significant aqueous alteration and a weak thermal alteration. Both their mineralogical and organic composition, as well as their aromatic component, classify these grains of the Paris meteorite close to the CI or CM meteorite-type.

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