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Primitive asteroids: irradiation and spectroscopy, in laboratory and in space

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Primitive extraterrestrial materials are characterized by a large heterogeneity of composition at small scales. This heterogeneity is observed in the laboratory on some meteorites and interplanetary dust with different techniques. Among these, infrared micro-spectroscopy has the advantage of being totally non-destructive and allowing a direct comparison with the astronomical observations of the minor bodies of the Solar System. Thanks to recent developments of "Focal Plan Array" matrix detectors, high spatial resolution and short acquisition IR mapping and IR tomography are now possible. In this presentation I will show some recent measurements of FTIR spectral imaging on different extraterrestrial materials, obtained in collaboration with the SMIS beamline of the SOLEIL synchrotron (France).
In the second part I will present new spectral imaging data of meteorites irradiated in the laboratory with 40 keV ions, as a simulation of solar wind irradiation of the asteroid surfaces. Together with the irradiation effects measured in the particles of the asteroid Itokawa (collected by the Hayabusa mission), these experiments support the spectral interpretation of the observations of asteroids, to establish a link between asteroids and meteorites and to understand the energetic processes that modify the surfaces of the small bodies. In samples irradiated in the laboratory we observe spectral variations of organic and mineral components, as well as variations in albedo. These irradiation effects as a function of the dose are then compared on a micron-scale with the compositional heterogeneity of the original materials, to determine which spectral bands are more sensitive to the effects of space weathering.
The results will be discussed in the context of the asteroid sample return missions Hayabusa2 (JAXA) and OSIRIS-REx (NASA).

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