LABORATORY ION IRRADIATION OF CARBONACEOUS CHONDRITES TO REPRODUCE SPACE WEATHERING OF DARK ASTEROIDS

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Introduction: The unprotected surfaces of asteroids are continuously modified by space weathering processes such as micrometeorite bombardment or solar wind ion irradiation. These produce changes on the surface of airless bodies, impeding us to decipher their composition from their spectra. Surface space weathering has been widely studied in the case of the Moon and S-type asteroids, and it is now investigated for primitive asteroids [1]. By performing ion irradiation experiments on relevant asteroid analogues, we can simulate some of the energetic processes affecting asteroid surfaces.

Materials and methods: In order to understand the influence of space weathering on carbonaceous asteroids and to support current sample return missions (Hayabusa2/JAXA and OSIRIS-REx/NASA), we performed 40 keV He^+ and Ar^+ ion irradiation of carbonaceous chondrites (CCs) as a simulation of solar wind irradiation of C-complex asteroids. We used reflectance spectroscopy (0.4-16 μm) to probe our samples before, during and after irradiation. We studied several types of CCs [2] as they span a wide range of albedos (from 2-8% for CI/CM to 10-18% for CV/CO), initial composition (matrix- or chondrules-rich) and did not suffer the same thermal history (different aqueous alteration or metamorphism).

Results and discussion: 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. We will show measurements of FTIR spectral imaging on different irradiated CCs [3], obtained in collaboration with the SMIS beamline of the SOLEIL synchrotron (France). The results of these experiments will be used both to support the analysis of samples retrieved from space [4] and to formulate predictions about the weathering trends that should be measured on asteroid families by remote sensing spectroscopy [5].

Acknowledgments: The FTIR microspectroscopy activities are supported by grants from Région Ile-de-France (DIM-ACAV) and SOLEIL. This work is funded by the Centre National d'Etudes Spatiales (CNES-France, Hayabusa2 mission) and by the CLASSY project (Grant ANR-17-CE31-0004-02) of the French Agence Nationale de la Recherche. The irradiations are performed using the INGMAR setup, a joint IAS-CSNSM (Orsay, France) facility funded by the P2IO LabEx (ANR-10-LABX-0038) in the framework Investissements d'Avenir (ANR-11-IDEX-0003-01). We warmly thank the Natural History Museum of Vienna (Dept. of Mineralogy and Petrography; Lancé NHMW_ID_3593_[3] (von A958) and Allende NHMW_ID_413_[5]), the Vatican Observatory (Alais and Mighei), J. Brucato (Tagish Lake), and L. Folco (FRO 95002) for providing us with the meteorite samples. We thank D. Ledu and C.O. Bacri for access to the SIDONIE facility, and the "Astrochimie et Origines" (IAS) and SMIS-SOLEIL teams for help and useful discussion.

References:

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