**PHOTOCHEMISTRY OF MOLECULES IN TERRESTRIAL ORBIT AND IN THE LABORATORY: APPLICATIONS TO MARS, TITAN, METEORITES AND COMETS.** H. Cottin[1], Y.Y. Guan[1], F. Stalport [1&2], M. Cloix[1], F. Macari[1], M. Jérome[1], C. Philippon[1], P. Coll[1], N. Fray[1], C. Szopa[3], F. Raulin[1], Chaput[4], M. Bertrand[5], A. Chabin[5], F. Westall[5], A. Brack[5]
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**Introduction:**

Photochemistry is leading the chemical evolution in the Solar System. The VUV photolysis of organic compounds is easy to study in the laboratory, with monochromatic sources, but it is difficult to simulate the whole range of wavelengths corresponding to the most energetic part of the Solar radiation (<190nm). This is why the results obtained in laboratory are difficult to extrapolate to the extraterrestrial environments. Space is the only laboratory allowing the exposure of samples to all the space parameters simultaneously.

**UVolution and PROCESS experiments.**

The preparation and results of two experiments in Terrestrial orbit, UVolution and PROCESS, selected and implemented by the European Space Agency (ESA), will be presented. The experiments were carried out on a FOTON capsule, using the BIOPAN facility (UVolution Sept.2007), and on the International Space Station, using the EXPOSE-Eutef facility (PROCESS 2008-2009).

In this project, organic molecules related to the study of the chemistry of Mars, Titan, meteorites or comets have been exposed in space between 10 days and 18 months (according to the experiment). Both solid samples and, for the first time in such experiments, thanks to supports from CNES to develop sealed cells, gaseous mixtures were exposed. Samples returned to Earth after the experiments have been analyzed in the laboratory.

After processing of the measurements, the photochemical lifetime of the molecules at 1 AU is calculated, and can be extrapolated at other heliocentric distances and other astrophysical environments (diffuse interstellar medium, dark clouds).

The results have been compared to laboratory simulations using a microwave powered $H_2$/He UV lamp as an energy source. Differences between laboratory and space experiments will be discussed.

**Molecules exposed.**

The molecules selected have been studied for different aspects of exobiological interests: nitrogenous bases (adenine, guanine, xanthine, hypoxanthine), amino (glycine, isobutyric acid, …) to measure their stabilities to space conditions. Carboxylic acids have also been selected for Mars' interest researches. They have been exposed either in pure form, or mixed with a martian soil analog. Biotic and abiotic carbonates have also been exposed. Thanks to the closed cells, gaseous mixtures simulating the atmosphere of Titan ($N_2$ & $CH_4$) have also been exposed.

This work should contribute to a better understanding of the evolution of molecular structures in extraterrestrial environments and their potential implication in exobiology.