OREOcube – ORganics Exposure in Orbit: In-Situ Spectroscopy of Organic Compounds on the International Space Station. S. Wolf[1], A. Elsaesser[1], R. Quinn[2], A. Mattioda[2], A. Ricco[2], F. Salama[2], A. Kros[3], H. Cottin[4], E. Dartois[5], L. d'Hendecourt[5], B. Foing[6], Z. Martins[7], M. Sephton[7], M. Spaans[8]
[1]Free University of Berlin, Berlin, DE (a.elsaesser@fu-berlin.de), [2]NASA Ames Research Center, Moffett Field, CA, USA, [3]Leiden University, Leiden, NL, [4]LISA, Université Paris Est-Créteil, Paris, FR, [5]IAS, Orsay, FR, [6]ESTEC, Noordwijk, NL, [7]Imperial College, London, UK, [8]University of Groningen, Groningen, NL

Introduction: OREOcube (ORganics Exposure in Orbit cube) is a space exposure platform and part of a new 'European Exposure Facility', which is currently under development by the European Space Agency (ESA). It will be placed on the exterior of the International Space Station (ISS) in order to investigate the effects of solar and cosmic radiation on specific organic compounds. These compounds are studied in the form of thin films, which are deposited on inorganic substrates to study the role that solid mineral surfaces play in the photochemical evolution, transport and distribution of organics in our solar system [1].

The kinetics of structural changes will be investigated via in-situ UV-Vis-NIR spectroscopy, which allows to monitor photochemical changes while samples are being exposed to conditions in low Earth orbit (LEO) for up to 18 months. OREOcube leverages heritage from the O/OREOS (Organism/Organic Exposure to Orbital Stresses) nanosatellite and its SEVO (Space Environment Viability of Organics) payload [2]. Installation of OREOcube on the ISS offers the great advantage that samples will be returned to Earth for a complete chemical analysis in order to understand the chemistry of organic species associated with mineral surfaces in an astrobiological context. OREOcube will provide data sets that capture critical details of sample reactions that are not obtainable with the current exposure facilities on the ISS [3].

Implementation: OREOcube will measure organic compounds of astrochemical importance such as porphyrins, quinones and polycyclic aromatic hydrocarbons (PAHs). All these compounds display strong features in the UV and Vis range. The organic thin films will be deposited on inorganic substrates such as Iron oxide (Fe_xO_y), Titanium oxides (TiO_2), Iron and Iron-nickel alloys and Iron Sulfide (FeS_2).

To examine which organic/inorganic compounds are appropriated for the OREOcube experiment, we will perform pre-flight laboratory exposure experiments, subjecting samples to simulated solar light while being monitored spectroscopically. Spectroscopic measurements are ideally suited to determine the stability, modification and degradation rates of various organic compounds, which have been identified in interstellar/planetary space, comets, meteorites or are anticipated to be present in space.

Outlook: OREOcube is anticipated to be launched to the ISS in 2018/19 by ESA. Pre-flight data is currently being analyzed and additional experiments will be conducted in preparation of the flight phase of OREOcube. Samples are designed to not only investigate the photochemical evolution of organic/inorganic thin film combinations but also the influence of a planetary atmosphere (e.g. Mars). This will allow us to study in detail the photostability of organic molecules and potential biomarkers relevant for astrochemistry and astrobiology.

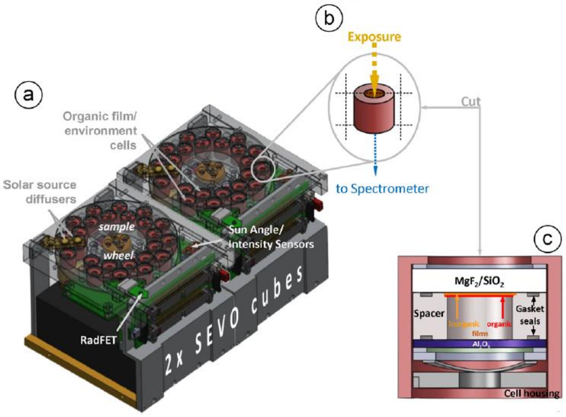

Fig. 1: (a) OREOcube consists of an identical pair of 10 cm cube instruments, each containing a UV-Vis-NIR spectrometer (using the Sun as a light source) and a 24-sample carousel. (b) Samples are mounted in individual sample cells with controlled internal gas phase environments. (c) Cross-sectional view of 1 of the 24 sample cells: Sunlight enters at the top through the MgF_2 or SiO_2 window, the transmitted light is collected at the bottom of the cell after passing through the lower Al_2O_3 window (adapted from [3]).

Acknowledgements: Current European funding for OREOcube is provided by the German Federal Ministry of Economics (BMWi). Z.M. is funded by a Royal Society University Research Fellowship. A.M., A.R., R.Q., and F.S. acknowledge prior support from the NASA. ASTID Program. R.Q. acknowledges ongoing support from the NASA Astrobiology Institute-U. Wisconsin Team.

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