TESTING THE SURVIVAL OF MICROFOSSILS DURING ENTRY INTO THE EARTH'S ATMOSPHERE: THE STONE 6 EXPERIMENT. F. Foucher[1], F. Westall[1], F. Brandstätter[2], R. Demets[3], J. Parnell[4], C. Cockell[5], H. Edwards[6], G. Kurat[2], A. Brack[1]. [1]Centre de Biophysique Moléculaire, CNRS, Orléans, France, E-mail: frederic.foucher@cnrs-orleans.fr, [2]Natural History Museum, Vienna, Austria, [3]ESA-ESTEC, Nordwijk, The Netherlands, [4]University of Aberdeen, UK., [5]Open University, Milton Keynes, UK, [6]University of Bradford, UK.

Introduction: Studies related to the origin of life on Earth are hampered by the fact that suitable rocks dating from the first billion years are lacking due to metamorphism and plate tectonics. Thus the oldest traces of life occur in rocks formed ~3.5 billion years ago [1,2], a billion years after the formation of the Earth. As a consequence, the investigations now focus on Mars where the ancient terrains have not been destroyed by plate tectonic activity.

One means of studying hypothetical martian traces of life would be to analyze sedimentary meteorites. However, only 49 meteorites of presumed martian origin have been so far been found and all have a basaltic composition. The aim of this study was to determine if sedimentary rocks and their embedded microfossils could survive the shock of entry into the Earth's atmosphere.

Experiment: The STONE 6 experiment (September 2007, ESA) tested the survivability of samples fixed on the apex of the heat shield of a FOTON capsule during entry into the Earth's atmosphere. One of these samples, from the 3.466 Ga-old Kitty's Gap Chert, in the Pilbara region, NW Australia, was composed of silicified volcanic sand deposited in a littoral environment. This rock is considered to be a good analogue for lithified martian volcanic sediment and contains small colonies of fossilized prokaryote-like microorganisms [2].

Results: Of the original 2 cm sample thickness, 8 mm remained after ablation upon entering the Earth's atmosphere. Several types of analyses were made to observe and study the survival of the microfossils and the modification of the rock composition. Optical observations show that a white fusion crust formed during entry. This contrasts with black crust of basaltic meteorites and may explain why sedimentary stony meteorites have not been yet found (meteorite hunters look for black fusion crusts). Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM) were used to observe the sub-micrometric microfossils. Raman spectroscopy was also used to study the changes in the carbonaceous matter and minerals throughout the sample thickness, up to the fusion crust. Although the kerogenous material near the fusion crust is graphitized, we demonstrate that the microfossiliferous structures located deeper in the sample were well preserved. An analytic model is also proposed to estimate the variation in temperature throughout the thickness of the sample. This model is consistent with the observed alteration of the minerals. We conclude that, if sedimentary Martian meteorites were found on Earth, they could contain eventual traces of extraterrestrial life and maybe of the first living organisms.

References:

[1] J. W. Schopf et al. 2007. *Precambrian Research* 158:141-155. [2] F. Westall et al. 2006, *Geological Society of America* Special Paper 405:105-131.