THE STONE X EXPERIMENT: SIMULATING METEORITE ATMOSPHERIC ENTRY AND ITS CONSEQUENCES FOR MICROBIAL LIFE. J. Le Galudec, F. Foucher, F. Gaboyer, A. Brack, and F. Westall, Centre de Biophysique Moléculaire, CNRS, rue Charles Sadron, 45071 Orleans, France, frederic.foucher@cnrs.fr.

Introduction: Life may have appeared on Mars during the Noachian period (<3.8 Ga) when environmental conditions were more favorable, in particular with the presence of liquid water. Nevertheless, given the punctuated nature of habitability on spatial and temporal scales, any life forms that could have developed would have been very primitive, remaining in a chemotrophic state, with direct consequences for in situ detection – difficult except in the direct vicinity of nutrient-providing hydrothermal vents (Westall et al. 2013, 2015). A sample return mission is planned in order to study Martian rocks with high resolution laboratory equipment, but another solution could and has been envisaged: to find microfossils or even living microorganisms in Martian meteorites. It had been proposed that a fractured volcanic cumulate rock, the 3.9 Ga-old ALH84001 meteorite, contained traces of past martian life (McKay et al., 1996), but this finding is still debated. To date, approximately 100 Martian meteorites were found on Earth, but none of them were made of sedimentary material.

The STONE experiments: To understand the absence of Martian sedimentary meteorites, the STONE experiments created artificial meteorites by embedding rock samples in the heat shield of FOTON capsules that re-entered the atmosphere. These experiments showed that sedimentary rocks and the potential traces of microbial remains they contain (microfossils) could survive atmospheric entry but that they are not necessarily identifiable due to the absence of or to the white color of their fusion crust (Brack et al. 2002, Brandstätter et al. 2008, Foucher et al. 2010). Unfortunately, the STONE program is now over. The aim of this work is thus to reproduce the STONE experiments in the laboratory and to carry out a pseudo-STONE experiment.

The STONE X experiment: The STONE X experiment aims at examining the panspermia hypothesis. Living cells of two different thermophile strains (Geobacillus subterraneus and Sulfolobus solfataricus) were placed at different depths within a 10 cm long, 2.5 cm wide basalt column, the basalt being considered to be a good analogue of Martian rocks (McSween et al. 2009). The temperature gradient estimated after the STONE 6 experiment (Foucher et al. 2010) was simulated by using an ethylene/acetylene blowtorch (Fig. 1).

Fig.1: The STONE X experiment.

The sample was then analyzed by various methods including optical and electronic microscopy and Raman spectroscopy. The survival rate of the cells was determined by the most probable number method. Although the thermal gradient of atmospheric entry was difficult to reproduce, the first results are relatively encouraging. Experiments are in progress in order to improve the protocol and, if successful, they could open the door to further testing with other rocks and/or biological samples.

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