INSIDE THE METEORITE – bacterial spore survival after exposure to galactic cosmic radiation.
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Abstract: Based on their unique resistance to various space parameters, bacterial spores (mainly spores of *Bacillus subtilis*) are one of the model systems used for astrobiological studies. More recently, spores of *B. subtilis* have been applied for experimental research on the likelihood of interplanetary transfer of life. Since its first postulation by Arrhenius in 1903, the panspermia hypothesis has been revisited many-times, e.g. after the discovery of several lunar and Martian meteorites on Earth[1,2]. These information provided intriguing evidence that rocks may naturally be transferred between the terrestrial planets. The scenario of panspermia, now termed "lithopanspermia" involves three basic hypothetical steps: (i) the escape process, i.e. removal to space of biological material, which has survived being lifted from the surface to high altitudes; (ii) interim state in space, i.e., survival of the bio-logical material over time scales comparable with interplane-tary or interstellar passage; (iii) the entry process, i.e. nondestructive deposition of the biological material on another planet[2].

In our research, spores of *B. subtilis* were used to study the effects of galactic cosmic radiation on spore survival and induced mutations. On an interplanetary journey, outside a protective magnetic field, spore-containing rocks would be exposed to bombardment by high-energy charged particle radiation from galactic sources and from the sun, consisting of photons (X-rays, γ-rays), protons, elec-trons and heavy, high-energy charged (HZE) particles. Air-dried spore layers on three different host materials (i.e., non-porous igneous rocks (gabbro), quartz, and spacecraft analog material (aluminum)) were irradiated with accelerated heavy ions (Helium and Iron) in the LET (linear energy transfer) range of 2 and 200 keV/µm, as previously shown by Moeller et al. (2008)[3]. To simulate the interplanetary journey of a meteorite, stacks of spore-samples on gabbro slides in different depths were exposed. Spore survival and the rate of the induced mutations (i.e., sporulation-deficiency (Spo-)) depended on the LET of the applied species of ions and as well as on the location (and depth) of the irradiated spores in the artificial meteorite, whereas the exposure to high-energy charged particles, e.g. iron ions, led to a low level of spore survival and increased frequency of mutation to Spo- compared to low-energy charged particles. In order to obtain insights on the role of DNA repair by nonhomologous end joining (NHEJ), homologous recombination (HR) and apurinic/apyrimidinic (AP) endonucleases in *B. subtilis* spore resistance to high-energy charged particles has been studied in parallel. Spores deficient in NHEJ and AP endonucleases were significantly more sensitive to HZE particle bombardment than were the HR-mutant and wild-type spores, indicating that NHEJ and AP endonucleases provide DNA break repair pathways during spore germination.

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