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Guest Editorial

Introduction to the EXPOSE-R Mission

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The EXPOSE-R mission has been the second of a series of open space exposure missions performed by the European Space Agency (ESA) on board of the International Space Station (ISS) within its European Life and Physical Science (ELIPS) programme. This programme provides – among other space experiment opportunities – long-term astrobiology experiments in open space external to the ISS. Following the successful flight of the first EXPOSE mission 'EXPOSE-E' together with the European ISS laboratory module Columbus in February 2008, the EXPOSE-R payload was launched with a Progress cargo carrier to the ISS on November 26, 2008. EXPOSE-R ('R' stands for its mounting on the Russian module Zvezta) was attached to the external platform 'URM-D' of the Zvezda module by Russian cosmonaut's extravehicular activity (EVA) on March 11, 2009 and the exposure of the astrobiological samples to selected space parameters was initiated. Exposure to outer space conditions continued for 682 days until January 21, 2011. The EXPOSE-R unit stayed on the ISS for the next mission (EXPOSE-R2) and the sample trays were brought back to Earth by the last Discovery Shuttle flight STS 133 on March 9, 2011. The different samples were subsequently distributed to the different research teams for post-flight analyses. This special issue comprises the results of the EXPOSE-R mission.

EXPOSE-R accommodated two chemical and seven biological experiments with the following scientific aims:

- The experiment AMINO dealt with photochemical processes induced by Solar extreme UV radiation in a variety of chemical substances, such as methane, amino acids, nucleic acids, which are connected to chemical evolution processes in comets, carbonaceous meteorites and micrometeorites, the atmosphere of Titan and to the RNA world hypothesis.
- The experiment ORGANIC concentrated on the evolution of carbon polymers, such as polycyclic aromatic hydrocarbons (PAHs) relevant to the processes occurring in the interstellar medium and circumstellar clouds.
- The biological experiments ENDO, OSMO, SPORES, PHOTO, PUR and SUBTIL were performed by the Responses of Organisms to the Space Environment (ROSE) consortium. The main objectives of those ROSE experiments were as follows:
  - To study the photobiological/photobiochemical processes in the simulated radiation climate of planets (e.g. early Earth and Mars) in order to determine their habitability.
  - To study the probabilities and limitations for life to be distributed among the bodies of our Solar System (e.g. between Earth and Mars and *vice versa*).

Halophilic micro-organisms, nucleic acid bases and bacterial and fungal spores embedded in dust simulating Martian regolith, and cyanobacteria embedded in impact-shocked gneiss were exposed to selected parameters of outer space, including Solar extraterrestrial UV radiation, cosmic radiation, space vacuum and extreme temperature fluctuations.

- In addition, a diversity of biological specimens, from micro-organisms to plant seeds, was provided by the Institute of Biomedical Problems, Moscow, Russia, for exposure within EXPOSE-R.

Supplementary dosimetric data on the cosmic radiation exposure of the samples were provided by the experiment R3DR and by thermoluminescence dosimeters, which were located in close neighbourhood of the samples. The UV radiation fluence was calculated by RedShift Design and Engineering BVBA, Belgium. The EXPOSE-R hardware was built by Kayser-Threde GmbH, now OHB System AG, Munich, Germany and by RUAG Schweiz AG, RUAG Space, Zürich, Switzerland. EXPOSE-R operations were supported by the German User Support and Operations Center (USOC) at DLR, Köln, Germany. The EXPOSE-R team is grateful to Cambridge University Press for offering the opportunity of publishing the scientific results in the International Journal of Astrobiology, and Rocco Mancinelli for his support during the preparation of this special issue.