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THE MARS 500 EXPERIMENT MICHA: BIOBURDEN AND BIODIVERSITY IN A CONFINED HABITAT

Abstract

Mars 500 is the first full duration simulation of a manned flight to Mars. It was performed from June 2010 to November 2011 by the Institute of Medical Problems in Moskow together with ESA and international partners. The crew, six volunteers from different countries, lived, worked and performed scientific experiments in a closed spacecraft-like habitat. This isolation project was a unique opportunity to investigate the impact of confinement on human and environmental microbial communities. The scientific experiment MICHA (Microbial ecology of confined habitats and human health) aimed at the survey of the microbial flora in the Mars 500 facility from the start till the end (520 days) of the simulation study. During the confinement the bioburden and biodiversity as well as their changes over the time were monitored using different sampling tools for surfaces and air (i.e. swabs and air filters). The samples were taken monthly at several selected locations (9 for air sampling, 11 for surface sampling) inside the habitat by the crew members and stored frozen for the analysis by the scientific team. The determination of cultivable microorganisms showed that the overall bioburden in the air and on different surfaces was moderate compared to other non-confined rooms. The highest number of microorganisms were found in the air of complex EU-150 where the crew members spent most of their time, i.e. community room, dining area and one tested individual compartment. This corresponds roughly to the results from surfaces at the different locations. In certain periods during the project changes in bioburden were seen. These have to be analysed in more detail taking the crew activities in the different modules, the cleaning regimes, the air conditioning processes etc. into account. The identification of bacterial isolates is ongoing. First results indicate the dominance of microorganisms associated with humans, especially Staphylococcus species, whereas environmental microorganisms are found to a lesser extent. Besides cultivation based analyses, the microbial inventory will also be studied on molecular level via DNA isolation, 16S rRNA gene specific

amplification and the construction of clone libraries. Further studies include the quantitative estimation of the bioburden inventory of the assembly building via quantitative real-time PCR. The collection of bioburden and biodiversity data is essential to develop strategies to maintain a non-hazardous environment for the astronauts during long time manned space missions. Furthermore, all our investigations are required for the implementation of planetary protection guidelines for manned Mars missions.