Mars Exploration (3)
Mars Exploration (1) (1)

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STRATEGY OF REGOLITH UTILISATION IN HUMAN HABITATS FOR LONG DURATION EXPEDITIONS ON MARS

Abstract

In the context of long-term human presence on Mars, solutions for building a habitat using regolith are investigated. The first objective of this study is to investigate the radiation protection offered by Martian regolith and render a six-month-long presence on the surface not riskier than on the International Space Station. Therefore, the upper limit for the whole-body effective dose during the presence on the surface of Mars for six months is fixed here to 150 mSv. This threshold doesn't include the dose received during the travel from Earth to Mars and back, for which other means for protection will be developed. The strategy applied in this work is to protect the whole habitat from the hazards of Galactic Cosmic Rays (GCR) and design a dedicated shelter area for protection during a Solar Particle Event (SPE).

Regolith utilisation in multilayer structures is studied to optimise the material used to build the habitat and reduce the radiation exposure. Our simulations using the NASA OLTARIS tool show that the whole-body effective dose decreases significantly when a multilayer structure mainly constituted of regolith is used instead of pure regolith. The results from these studies are not only important for designing the ideal habitat, but also for predictions about the depth of the Martian surface at which some bacteria, if any, could have survived.

The second objective is this work is to assess the thermal properties of Martian regolith to determine whether the main layer of the structure is a good insulator, which would facilitate the work of the environment and life support system of the habitat. For a more complete solution for the human outpost on Mars, the case of surface expeditions has to be addressed. For Extravehicular Activity Units, alternative materials are considered for radiation protection, such as Kevlar, neoprene and different kinds of aerogels. Assessment of these materials in a multilayer is made to approximate the difference in the protection of an astronaut at the base made predominantly of regolith and her/his crewmate outside.