Exploring Mars Habitability

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Corresponding Author - Abstract submission form

Title	Dr
Family name	de Vera
Initial	J.P.P
Institution/Company	Institute of Planetary Research/ DLR e.V.
Department	Experimental Planetary Physics
Address	Rutherfordstr. 2
Postal code	12489
City	Berlin
Country	GERMANY
Telephone	+49-30-67055-309
Fax	+49-30-67055-507
E-mail	jean-pierre.devera@dlr.de
Please repeat your e-mail address	jean-pierre.devera@dlr.de

Abstract / Paper Title

Recent Mars: A Habitable Planet? – Results from Investigations in Space, in Mars Analogue Habitats and from Laboratory and Theoretical Studies

Abstract Text

Mars is a frozen desert planet. Considerable intense UV radiation fluxes reach its surface and with its thin and 95 % CO2 rich atmosphere and an atmospheric pressure of approximately 6 mbar this planet is not supposed to be habitable. But according to a variety of different experiments during the last decade where microorganisms were investigated under Mars-like environmental conditions there is evidence that even recent Mars appears to be a habitable planet. The habitability of the surface and upper subsurface of Mars depends on one hand on the viability and adaptation capacity of microorganisms to Mars-like environments and on the other hand on the planet's energy resources and liquid water availability. Besides chemical, inorganic energy sources in the soil intense solar radiation is available as additional energy source on the surface of Mars but might be harmful for most of known terrestrial life forms. However, previous studies on extremophilic microorganisms which were performed on space exposure platforms (e.g. BIOPAN on the satellite FOTON and EXPOSE on ISS) show the high resistance of tested bacteria, archaea and lichens to space radiation and desiccation caused by vacuum. During Mars simulation experiments photosynthesizing microorganisms are even able to do photosynthesis periodically. The periodicity of the photosynthetic activity depends on the diurnal cycle with its varying temperatures and relative humidity. It is important to emphasize that the aforementioned space resistant microorganisms are mainly collected in polar and alpine habitats. They are living in permafrost regions with high UV radiation income and extreme dryness provoking high adaptation strategies. Because of these environmental parameters the alpine, desert and polar habitats were characterized as Mars analogue. The Mars analogy of these regions can also be justified by comparing the colonized alpine and polar field profiles with surface structures on Mars. Numerous investigations were done during field campaigns in the Alps, the Arctic (Svalbard) and in Antarctica. Based on these field investigations it becomes obvious that gullies, polygon rich regions and micro caves, fissures and cracks in rocks can be seen as suitable candidates for habitable areas on the surface of Mars in addition to the

supposed ice rich environment in the subsurface. As mentioned above, the habitability of Mars depends also on the availability of liquid water. Due to the presence of salts and perchlorate rich soils on Mars water can for sufficient relative humidity remain in a liquid phase, forming at least temporary liquid cryobrines far below the freezing point, which e.g. might be useful for some halophilic microorganisms. This may be in favour of the habitability of the Martian surface. In addition the habitability can also be influenced by the sorption and desorption capacity of other soil particles. These particles and salty solutions could enhance the liquid phase of water. Processes enhancing the liquefaction of water might explain the recently observed rheological events provoking e.g. the formation of gullies on the surface of Mars which are known as real habitats for a diversity of microorganisms on terrestrial martian analogue environments mostly present in the polar regions. All presently enumerated factors are positively emphasizing that habitability of recent Mars is particularly probable for some of terrestrial life forms.

Topic

05 Modern habitability and the possibility of extant life.

Presentation Type

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List of Authors

de Vera, J.P.P., Institute of Planetary Research/ DLR e.V., GERMANY (Presenting); Hauber, E., Institute of Planetary Research/ DLR e.V., GERMANY; Jänchen, J., TH Wildau, Technical University of Applied Sciences, Wildau, GERMANY; Koncz, A., Institute of Planetary Research/ DLR e.V., GERMANY; Lorek, A., Institute of Planetary Research/ DLR e.V., GERMANY; Möhlmann, D., Institute of Planetary Research/ DLR e.V., GERMANY; Spohn, T., Institute of Planetary Research/ DLR e.V., GERMANY