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Mars Analog Field Work and Astrobiology

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Abstract

Mars analog field work fuses the essentials of outreach in astrobiology: interesting science question together with exploration at exotic terrain under unusual conditions (like work in space suit or with tools planned for astronauts). Basic characteristics of such projects at desert, arctic and salty environments are listed, indicating those issues that could be used to implement such projects to the education and use in public outreach. As next Mars missions' detectors will be regularly tested at, and astrobiologists will also collect samples at exotic terrains in the future too, it is strongly encouraged to use such activities in the public outreach of astrobiology.

Keywords: Mars; Earth analog; Field work

Introduction

Astrobiology is more than a popular topic of natural sciences in these days. Beside it fuses various disciplines, it also provides a new way to bring science close to the public. One of the most "exotic" subtopic is the analog field work aimed at astrobiology related research. Below we outline three examples how Mars analog field activity could be used to implement astrobiology in the popularization as well as education. Although this work reflects the view of the author, the increased interest for Mars analog work suggests that this topic should be better exploited in the education and outreach of astrobiology.

These field trips were realized as planned activities, aimed at the analysis of the occurrence of water in cold or dry terrains, and also to collect extremophile samples for laboratory testing. The terrains were partly known already, but Google Maps served as a useful tool in the identification of targets and traverses between them. The desert work at MDRS and FMARS stations (see below) were part of such analog research that beside science, also tested the methods and tools of future manned Mars expedition, including the realization in analog space suits.

Methods

This work summarizes ideas and suggestions of the outreach related activity during Mars analog field works. Specific details on the expeditions including their results can be found in related papers [1], and thus not discussed here. For the popularization during and after the missions, the following methods were used (examples for the way of presentation for young audience see [2]): printed journal papers, online articles [3,4], after the mission radio and TV interviews, public lectures at astronomical meetings [5], implementation of one lecture for each semester into the undergraduate education at university level [6,7].

Results

Field works aimed at astrobiology related analysis, mainly at Mars analog terrains were realized by the author and colleagues at three environment types, where expedition related outreach activity was also realized. The general parameters are listed below to provide context what topics could be used here in the outreach-while examples for the details on how to implement these issues into the education and popularization are presented in the Discussion and Conclusion section.

Desert environment

Two field works were realized at the Mars Desert Research Station (MDRS, Figure 1), Utah, USA in 2004 [8] and 2008. To provide Mars analog conditions a rocky desert with horizontal sandstone layers, and concretions occasionally cemented by hematite were present. This desert was characterized by dryness, ephemeral water flow curved channels, and cyanobacteria in cryptobiotic crust (often in "solar burned" rock surfaces with desert varnish). The two weeks long activities were realized in space suits and using planned field equipments of a human Mars expedition.

Arctic crater

The Flashline Mars Arctic Research Station (FMARS) is located at the 23 km diameter Haughton crater at on Devon Island, arctic Canada, where a one month duration expedition was realized in

Figure 1: Searching for cyanobacteria colonized cryptobiotic crust samples at Utah, during aMars analog field work.

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2004. The analyzed Mars relevant properties of this environment were: post-impact hydrothermal alterations in the faulted regions of the crater, summertime insolation driven ice melting on the surface and cyanobacterial colonisation inside the rocks. This work was also realized as Mars simulation inside space suits with planned traverses and field equipments of future a human Mars expedition.

Salty plains

In 2013 the Chott el Jerid Mars Analog Expedition was realized in Sahara, Tunisia. The field work focused on the unique salty environment there, including ephemeral channels, evaporite deposits and occurrence of salt tolerant cyanopbacteria. Samples were collected for later laboratory simulations [9]. It was realized as a regular expedition, with classical geologic field tools and a rover without space suit or other special equipments.

At the first two sites the participants sent daily emails including outreach sections for the remote science team and also for popular web portals. In the popularization section of these reports, images, maps with the traverse routes, high resolution photos of rock specimen and text description served to provide an interesting characterization of the area, mentioning the everyday life of the researchers, their problems and feelings about being isolated.

During the field works listed above the crews realized Mars relevant astrobiology research and in the first two sites testing the usage of space suits, driving with all terrain vehicles, work with equipments for astronauts along already planned traverses, using time delayed communication with the remote science teams and logging Extravehicular Activities were also part of the mission (EVAs).

Discussion and Conclusion

The above mentioned examples provide insight into the complex issues of Mars analog field work with astrobiology related aims. Beside the research results the different components of such expeditions could be effectively used in the public outreach to popularize astrobiology, including education related issues both at secondary school and university level. Using the experiences both during and after these missions Table 1. Summarizes the main connections and components of these field works that are connected to the popularization of astrobiology for the three terrain types. The Mars relevant issues are listed in the second column, the related topics could be used in the education are presented in the third and fourth columns for secondary schools and universities respectively, while the last column gives the keywords and key concepts on which topics to focus during the outreach activity.

Analog field work fuses the exact scientific analysis and the adventure at exotic environments. The increased occurrence of such recent analog field works [10-13] and planned next missions suggest that analog field activity will be even more frequent in the near future. In robotic planetary missions the exotic environment and the exploration of the unknown are the main factors that arouse the interest of the public toward these projects similar situation is present at Mars analog field work. The increased interest and the enthusiasm of the public could be used effectively to popularize astrobiology related issues (see some examples in the table). For more details on such activities see articles in the special issue of Astrobiology coming out around the end of 2013–beginning of 2014.

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Analog location	Mars and astrobiology related issues	Educational issues for secondary schools	Educational issues for universities	Topics for public outreach
rocky desert (Utah, San Rafael Desert, near Hanksville)	dryness, mechanical fragmentation, well preserved ephemeral channels	dune formation, daily temperature fluctuation, effects of wind	evaporation, UV radiation effects, UV screening pigmentation of cyanobacteria	desert landscape, extreme dryness, conditions difficult to survive, exotic expeditions in general
arctic location (Devon Island, Haughton crater)	low temperature, impact crater, hydrothermal alteration, ephemeral ice melting	average temperature, summertime insolation, annual change in the length of daytime,	low temperature metabolism, long frozen and dormant phase, characteristics of cell integrity	cold, isolation, communication difficulties, almost inaccessible locations, difficult field work
salty plains (Chott el Jerid, Tunesia)	high salt concentration, ephemeral brine lakes, salt and clay crust formation and specific erosional pattern on them	dissolution and salt crystal formation, concentration related basic chemistry of salty solutions	eutectic freezing, oversaturation, strong evaporation, freezing point depression in brines	great white plains with unusual scene, extreme surface chemistry, non potable water, table salt at “city wide” surface areas

Table 1: Characteristics at the three analog field work locations that could be used in education and public outreach.

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