HUNGAROMARS2008: ANALOG RESEARCH IN THE EDUCATION OF PLANETARY SCIENCE.

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Introduction The aim of the analog work at Mars Desert Research Station (MDRS) [1] is to simulate various scientific, engineering issues and realize human factor studies in order to help the first human exploration of planet Mars. The location of the station is useful for geological and biological analog field work to observe structures, processes and extremophyles possibly relevant to Mars. The station consists of three modules: the HAB (Hability) for living and laboratory work, a greenhouse for vegetable production and water recirculation, and there is a small observatory too with a 40 cm diameter telescope. During the HungaroMars expedirion we addressed another aspect: the usage of simulation in the planetary science education at university level.

Between 13-26 of April 2008, the first all Hungarian crew worked on MDRS as crew no. 71.: Mónika Boros-Oláh (astronomer, EVA coordinator), Henrik Hargitai (commander), Tibor Hirsch (journalist), Ákos Kereszturi (geologist), András Muhi (cinematographer), István Tepliczky (engineer). Five educational projects were realized in connection with planetary science, under the joint activity between the crew at MDRS, the Eotvos Lorand University of Sciences, the University of Pecs and the Polaris Observatory in Hungary.

Meteorological station: The goal is to set up a complete meteorological station called HUNMET (Fig. 1.), which communicates through Wi-Fi, retrieve the data 24/7, and useful to analyze the energy balance of the terrain.

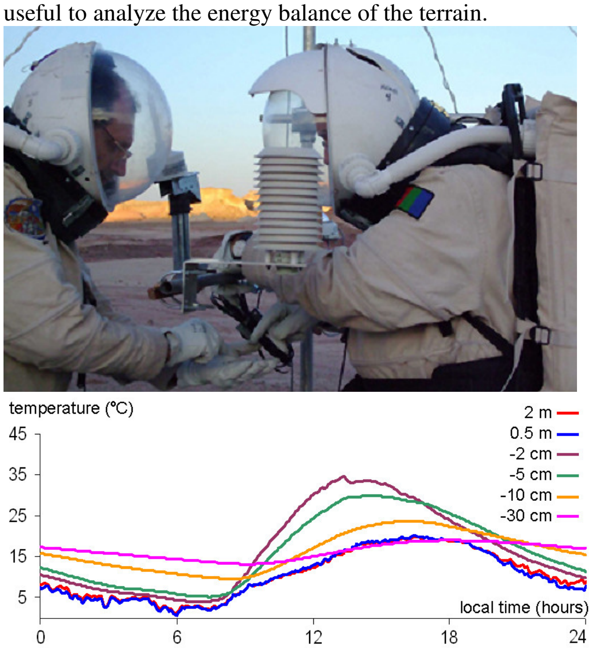

Fig. 1. Image of the meteorological station's installation (top) and daily curves of temperatures at different height/depth (colors) on 24th. April 2008

We also used mobile meteorological sensors (anemometers, thermometers, infrared thermometers) for discovering the micrometeorological differences (microclimates) of various terrain types around the HAB.

During our crew rotation the data, and a one minute long video was recorded in every half hour for 10 days at MDRS and at university too [2]. Scientists and some students worked as a remote team to help the maintenance of the system, and realized a remote update of the data logging computer's software. The data is under analysis, the first results were presented at two conferences [2,3]. The measured daily temperature fluctuation was around 30 °C, the maximal wind speed 60 km/h, and characteristic and repeated daily relative humidity change was observed. The intensity of the global insolation was about 900 W/m^2 at maximum, around noon. Small fluctuations in the afternoon were caused by clouds and dust storms. These results are useful in the analysis of planetary boundary layer on Earth [4] and can be extrapolated to Martian environment.

Husar 2d autonomous rover: The aim is to test how Husar 2-d rover (Fig. 2.) could help humans on an expedition [5]. The rover was part of an educational project, at the University of Pecs, where students designed and tested it. The rover sent the data from its webcam, thermometer via Wi-Fi connection. Continuous email consultation was maintained with the university to solve the problems.

Fig. 2. The Husar-2d rover driving between the rocks

Microbiological experiment package: The goal is to show the contamination from humans, in the HAB and its surrounding, and to show the presence of microorganisms using samples of the air (dust), the soil (various depths) and the surface. The package was realized in cooperation with Károly Márialigeti, (Eötvös Lorand University, Department of Microbiology). Based on the cultivation of the samples and the identified microbes a scale was calculated that shows the level of microbial contamination.

Geomorphology: using previous crew's photos we revisited the same sites of geomorphology interest, and tried to determine the extent of erosion in the past years or other changes in geomorphological parameters (Fig. 3.) [6].

Fig. 3. Changes of the same surface structures between 2006 (left) and 2008 (right)

Geologic research: Cryptbiotic crust samples were collected from large, black-brownish "burned", somewhere shining surface rocks.

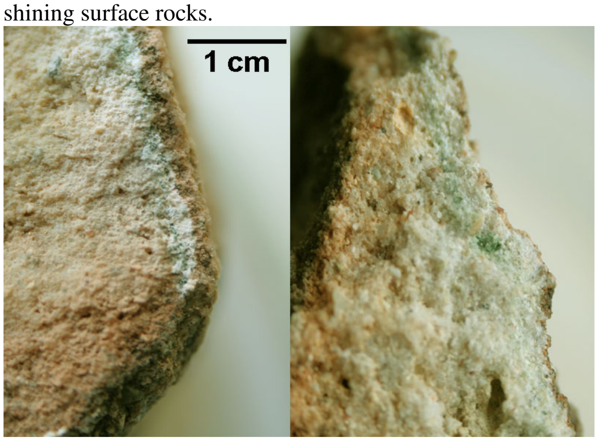

Fig. 4. Cryptobiotic crust samples. The greenish layer consist of cyanobacteria

Below the dark covering, at 1-3 mm depth a greenish layer is present (Fig. 4.), where great number of Croococcidiopsis cianobacteria was observed by Tamas Pócs (Collegium Budapest, Mars Astrobiology Group). The samples may serve for astrobiological analysis on the possibility of life under Mars analog terrain [7] and its comparison to Martan environment helps astrobiology related educational programs in Hungary [8].

Regarding human factor studies five projects were realized:

- **Psychology experiment:** with voice recordings and written documents, the Space Research Group of the Psychological Research Institute, Hungarian National Academy, analyzed the crew's psychological parameters in order to interpret or even partly predict the behavior of an isolated group during a long term Mars mission.
- **Media reports:** daily reports were written along with essays reflecting the day's activities for the journal Népszabadság to find out which issues of the analog work could be used to popularize planetary science for the public in connection with the work at MDRS.
- **Free time survey:** the use of free time (emailing, web surfing, listening to music, reading) was monitored, analyzed and compared to crew 42's results.
- **Food experiment:** "healthy space food" package was compiled for the expedition.
- **Place naming methods:** experiment has been started during crew 42's rotation and the first results have been published in the scientific journal Cartographica [9].
- **Film soothing:** a popular science movie about a human expedition (life and work) on Mars (Produced by Inforg Studio, Hungary) was realized as well as an educational movie on the requirements and characteristics of a human Mars expedition.

Conclusion: Based on our experiences analog work is useful to enhance student research work at university level. The successful work was most obvious at the level to synthesize different subjects (above all natural science + engineering + logistics, for example: atmospheric data + detector package design + remote analysis) in the education of planetary science at university level based on analog research.

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