EPSC Abstracts
Vol. 12, EPSC2018-300-1, 2018
European Planetary Science Congress 2018

The ScanMars radar onboard AMADEE-18 analog mission to Mars

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Abstract

Simulated, or analog, planetary missions are putting the base for the forthcoming extraterrestrial explorations, testing new technologies and refining existing operative exploration procedures [1, 2, 3].

In February 2018, the Austrian Space Forum led an international Mars analog mission in the Dhofar region, Oman. Directed by a Mission Support Center in Austria, a small field crew conducted experiments preparing for future human Mars missions in the fields of engineering, planetary surface operations, astrobiology, geophysics/geology and life sciences.

In summer 2017 our ScanMars experiment has been selected to be part of the mission. ScanMars employed a Ground Penetrating Radar to investigate the subsurface by transmitting and receiving radio-wave impulses into the ground. The expected results of the experiment are geophysical images of the underground structures, material differences and the presence of groundwater[4].

Here we present the ScanMars experiment and its results from AMADEE-18 analog mission to Mars, in the Oman desert.

1 Introduction

The instrumental part of the ScanMars experiment onborard AMADEE-18 consists of a Zond-12e Ground Penetrating Radar, developed by Radsys, Latvia. We choose the 500 MHz operative frequency as a good compromise between resolution, penetration depth and maneuverability. The experiment can be divided in three phases: the training, the scientific campaign and the scientific synthesis.

Figure 1: Analog astronauts testing operative procedures during the training at OEWF headquarters in Innsbruck, Austria.

2. Training Phase

The most different element from ScanMars a common radar fieldwork is undoubtedly the fact that the data was going to be acquired by the analog astronauts and not the scientists. Thus the astronauts' training becomes a critical part of the experiment. The challenge of this phase resides in the fact that the analog astronauts have a background which is not specifically trimmed on the experiment, and that they have to acquire a large quantity of diverse information during the training (Figure 1).

3. Scientific campaign

The training efforts have been put into practice during the ScanMars scientific campaign in the field in the Dhofar (Figure 2), where the field crew operated the radar over the planned scientific targets. The experiment explored four different sites with slight different geologic charac-

Figure 2: The analog astronauts during ScanMars experiment data acquisition. The radar sledge is being pulled along the planned profile.

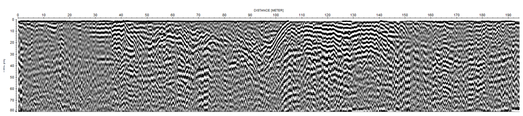

Figure 3: A data frame extracted from the experiment results. The radargram is the visual representation of the radar echoes recorded in the field, representing distance along the profile (horizontal) versus time delay (vertical).

teristics. The analog astronauts acquired about 1400 meters of profiles. A total of about 70000 radar echoes have been recorded and returned to the scientific data archive.

4. Results

Figure 3 shows one of the 25 radargrams which have been acquired in the field. The data quality is very good and the radar echoes show extremely well geologic features typical of the wadi riverbed. The penetration depth of the signals is about 5 meters, and in some case we can extract deeper information.

5. Conclusions

The ScanMars experiment can be considered successful not just because of the data acquired but more importantly we consider ScanMars a success due to the volume of new experience created among the scientific team, the operations' team and the field crew. A good teamwork has been necessary to face the problems which are difficult, when not impossible, to foresee beforehand. With ScanMars and AMADEE-18 in general we are understanding the different aspects of scientific exploration of distant worlds, developing strategies and workflows which will be the building blocks of the future human planetary missions.

Acknowledgements

Thanks to the AMADEE-18 personnel, from the astronauts, the field crew and the mission control, whose efforts turned the ScanMars experiment into a success. We are grateful to the volunteers of the Italian Radio Amateur Association (ARI) who assisted us in laboratory measurements and system optimization of the ScanMars radar hardware.

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