

# AMADEE-15



Rock Glacier Mars Simulation  
Kaunertal, Austria / Aug. 2015



## Press Kit AMADEE-15

## Rock Glacier Mars Simulation

### Contents

1	Summary and Contact Information .....	4
2	Overview of experiments .....	8
3	Austrian Space Forum .....	10
4	Experiment Details.....	11

## 1 PREFACE BY FEDERAL MINISTER ALOIS STÖGER, AUSTRIAN MINISTRY FOR TRANSPORT, INNOVATION AND TECHNOLOGY



Foto: Elisabeth Grebe

Austria is internationally recognised as aerospace nation and our contributions are highly appreciated. Our domestic technologies have an excellent reputation and in the meanwhile there is nearly no mission of NASA or ESA which is led without technology and knowhow from Austrian universities, institutes and companies. The Federal Ministry of Transport, Industry and Technology annually invests about EUR 65 million in the field of aerospace technologies and research and herewith significantly supports the “aerospace community” which has grown to more than 50 institutions from industry and research guaranteeing over 1,000 jobs. Austria is on a success path in the field of aerospace!

In this context it is an international distinction that in August 2015 the Austrian Aerospace Forum with international partners have organised a two-week Mars simulation on the ice and rock glaciers in the valley called Kaunertal (Tyrol) in Austria and a small field crew will carry out different experiments in preparation of future Mars missions. At the same time it is a pleasure for me that my Ministry together with the Austrian Aerospace Forum organises the Junior Researchers Program (JRP AMADEE15) and within the framework of fti offspring promotion it supports ftiemixed ([www.ftiremixed.at](http://www.ftiremixed.at)). 12 young persons between 16 and 19 years coming from Austria will participate in the Mars simulation AMADEE15 between 2 and 4 August 2015 and will experience this event very closely as journalists.

It is my special wish to gather young talents with innovate companies in science and research and to let them contribute in the development of future technologies of tomorrow. Since the start of the talent program 8,500 young persons with the support of the Federal Ministry for Transport, Innovation and Technology have completed a promoted program and also this year again about 1,500 young persons will be able to have a special look behind the scenery of research and technology.

I wish all participants of the international Mars simulation an exciting time and a lot of success in their experiments and I have the pleasure to express my gratitude to Mr. Dr. Gernot Grömer and to his whole team for the tireless commitment in the field of aerospace.

Federal Minister Alois Stöger

## 2 WORDS OF GREETING FROM THE GOVERNOR OF TIROL, GÜNTHER PLATTER



Foto: Land Tirol – Aichner

As Governor of Tirol I am very pleased that Tirol is reaching for the stars with the Mars field simulation AMADEE-15: The Austrian Space Forum chose the Kaunertal glacier for fieldwork to find important insights for future manned missions to Mars.

I would like to emphasize the fact that linked to the field research is a scientific educational project: twelve pupils between 16 and 19 years from Austria and Switzerland will work on the mission for two days, thus getting hands-on experience in space travel. They will inspire other youths as “Ambassadors for Space Travel” to find interest in research, technology and nature sciences.

I wish all participants two successful weeks at the Kaunertal glacier and I am convinced that the scientific insights won from the AMADEE-15 Mission will be an important contribution by the Austrian Space Forum to manned space travel.



Günther Platter  
Governor of Tirol

## 2 SUMMARY AND CONTACT INFORMATION

<b>Mission period:</b>	<b>1.-14. August, 2015</b>
<b>Executive Organisation:</b>	<b>Austrian Space Forum (OeWF)</b>
<b>Participants:</b>	<b>International organisations from the fields of space flight, outer space engineering and medicine.</b>

In August 2015, the Austrian Space Forum (OeWF) and international partners will conduct a two-week Mars simulation mission in the Kaunertal glacier region of Austria.

Directed by the Mission Support Center in Innsbruck/Austria, a small field crew performs experiments which will prepare future manned Mars missions in the fields of engineering, planetary surface operations, astrobiology and geosciences.

Analog astronauts in spacesuit simulators, in partnership with robotic vehicles, supported by an international Remote Science Support Team, will emulate the exploration of a Martian rock glacier.

### Contacts: Austrian Space Forum

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## 2.1 AMADEE-15 at a glance

The international AMADEE-15 Mission is the highest altitude human Mars simulation ever conducted and will take place on a rock glacier which will serve as an analog for future manned expeditions to (sub) surface ice regions on Mars.

The aims of AMADEE-15 are:

- **Investigate** the limitations and opportunities of studying a Martian rock glacier with human explorers, using state-of-the art instrumentation and equipment.
- **Test** novel mission support strategies, decision making workflows and near-real time data analysis for flight planning.
- **Serve** as a high-visibility showcase of analog field research, including a dedicated education and outreach component.

### Science & Technology:

Based upon an extensive peer review process, a complimentary set of experiments was decided upon. These experiments focus on the geo-scientific exploration of a rock glacier, astrobiology, mission operation aspects, spacesuit and robotic systems as well as the flight planning and remote science support workflows pertinent to complex missions including time delayed communication.

Observers from industry, space agencies and academia are welcome to witness AMADEE-15 first hand during two professional observer days at the Mission Support Center, the test site and virtually.

### Outreach and Education:

In cooperation with PLANSINN GmbH, an experienced provider of science education and under contract with the Austrian Federal Ministry for Transportation, Innovation and Technology, the Austrian Space Forum manages the Junior Researchers Program for AMADEE-15. Twelve (12) Austrian students and two (2) Swiss students aged from 16 to 19 years will join the mission for two days as part of the professional observers program. After the visit, they will continue to engage communities as space exploration ambassadors, sharing their experiences with a wider audience in their respective social circles and work environments.






### Analog Astronauts:

These carefully selected and trained individuals execute most of the science field activities, and they are also the public face of the mission, serving as STEM-ambassadors for media and education activities.

Analog astronauts are trained to conduct spaceflight-simulations in Mars-like regions on Earth, testing and evaluating equipment procedures as well as human factors and workflows relevant to human exploration. They conduct experiments in field campaigns in an international and interdisciplinary environment, typically lasting from a few days up to one month. Analog astronauts contribute to the development of spacesuit simulators and other relevant instrumentation and equipment.

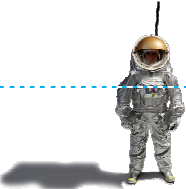
The AMADEE-15 mission is supported by a number of **industrial partners** with in-kind and financial support, also joining efforts in the outreach and education sector. The list of partners provided below is not final (traditionally, additional partners join towards the end of the preparatory phase).

	<ul style="list-style-type: none"> <li>• <b>MARKETING AND MEDIA SUPPORT</b></li> <li>• <b>CONDUCT OF A NATIONWIDE CONTEST (2 WINNERS VISIT THE FIELD CAMPAIGN DURING THE PUBLIC DAY AND THE MSC)</b></li> <li>• <b>“SAND IN THE CITY” EVENT IN JULY IN VIENNA</b></li> </ul>
	<ul style="list-style-type: none"> <li>• <b>DONATION OF THE SECOND GENERATION W-LAN NETWORKING HARDWARE FOR OUR FIELD CAMPAIGNS</b></li> </ul>
	<ul style="list-style-type: none"> <li>• <b>IN-KIND &amp; DIRECT CONTRIBUTIONS, SPONSORING OF DH DINNER &amp; GOODIES</b></li> </ul>
	<ul style="list-style-type: none"> <li>• <b>DIRECT CONTRIBUTION</b></li> </ul>
	<ul style="list-style-type: none"> <li>• <b>MARKETING/SOCIAL MEDIA SUPPORT, DIRECT CONTRIBUTION AND INVITATION OF KEY CUSTOMERS TO THE FIELD</b></li> </ul>
	<ul style="list-style-type: none"> <li>• <b>DEVELOPMENT OF THE NEXT AOUDA HELMET EVOLUTION 2015</b></li> </ul>
	<ul style="list-style-type: none"> <li>• <b>PROVISION OF FIRST AID AND GENERAL SAFETY EQUIPMENT</b></li> </ul>
	<ul style="list-style-type: none"> <li>• <b>DEVELOPMENT OF THE AMADEE-15 BASE STATION MODULE</b></li> </ul>

	<p><b>SPECIAL FIRE EXTINGUISHER AND GLOVES</b></p>
	<p><b>SPECIAL TOOL KIT</b></p>
	<p><b>SPONSORING</b></p>
	<p><b>SPONSORING</b></p>
	<p><b>„BOCK“ MOBILE ROBOT-PLATTFORM</b></p>



### 3 OVERVIEW OF EXPERIMENTS

	Experiment	Organisation	Description
SPACE SUITS	<u><a href="#">Aouda.X spacesuit</a></u>	Austrian Space Forum	Study of contamination vectors in planetary exploration analog environments. Creating limitations depending on the pressure regime chosen for simulation.
	 <b>Cliffbot</b>	Planète Mars Association, French Chapter of the Mars Society, France	In order to have access to difficult-to-reach locations on Mars, such as cliff strata, which may reveal important information about conditions that existed in the past on that planet, the Association Planète Mars (France) has designed manually operated, instrumented vehicles capable of being lowered down the faces of cliffs.
ROVERS	<u><a href="#">PULI ROCKS</a></u>	Puli Space Technologies, Hungary	During the AMADEE-15 field experiments a rover will be tested to demonstrate its capability to be operated by remote mission control from Budapest. In addition its reliability and moving capabilities on extreme, hard terrain will be tested.
	<u><a href="#">L.I.F.E.</a></u>	University of Innsbruck, Institute of Ecology, Austria	The L.I.F.E instrument (Laser-induced Fluorescence Emission) is a portable non-invasive tool that is capable of detecting and quantifying biomarker molecules in extreme environments.
LIFE SCIENCES	<u><a href="#">Glacier-MASE</a></u>	Medical University Graz, Department of Internal Medicine, Austria German Aerospace Center, Germany	Assessing the habitability of Mars and detecting life, depends on the knowledge of life itself and its tolerance towards (extreme) environmental conditions. The MASE experiment will perform sampling and life-detection experiments.



	Experiment	Organisation	Description
LIFE SCIENCES	Dental Treatment on Mars – MaDe	Meusburger Dental Technic And Space-Craft Architektur	This research project combines the technical feasibility of 3D Technology and dental technology and presents a new field for human space flight.
ENGINEERING AND INFRASTRUCTURE	<a href="#"><u>VEMES</u></a>	Mars Society, Italy	The V-ERAS infrastructure will substitute elements of future Mars analog missions with virtual components for both training and exploration technology testing activities.
	<a href="#"><u>FOG</u></a>	OBRAM S.A., Poland	The aim of the project is to confirm that it is possible to effectively wash the human body using water mist and therefore seeks to solve the problems connected with limited water resources.
	<a href="#"><u>BCC</u></a>	Planète Mars Association, French Chapter of the Mars Society, France	A balloon carried camera will be tested. It might support astronauts in exploration on Mars by providing full terrain views taken from above. Pictures taken may be used for direct video transmission, to map the path followed by the astronauts and to document the operations conducted.
GEOSCIENCES	<a href="#"><u>GPRoG</u></a>	University of Athens, Department of Geophysics and Seismology, Greece	In this survey, ground penetrating radar data will be collected
	<a href="#"><u>LICHEN</u></a>	University Warsaw, Poland)	During the AMADEE-15 Mission the analogue astronauts will measure <i>Rhizocarpon</i> lichen diameters and read the Schmidt hammer R-values across a moraine ridge of the Kaunertal glacier. Thus they will determine the age of the moraine.
	<a href="#"><u>WoRIS</u></a>	Polish Academy of Sciences / OeWF RSS (Remote Science Support)	Investigation of the rate of cryoconite development (that is increase in their depth and width through time) on a glacier depending on the rocky particle's albedo, emissivity and size as well as thermal conductivity of ice.

## 4 AUSTRIAN SPACE FORUM

The Austrian Space Forum (Österreichisches Weltraum Forum, OeWF) is a national network for aerospace engineers, scientists and people with a passion for space. The citizen-science organization is involved in leading-edge space exploration research and serves as a communication platform between the space sector and the public; it is embedded in a global network of specialists from the space industry, research and policy.

Hence, the Austrian Space Forum facilitates a strengthening of the Austrian space sector through enhancing the public visibility of space activities, technical workshops and conferences as well as Forum-related projects.

The Forum has a small, but highly active pool of professional members contributing to space endeavours, mostly in cooperation with other - national as well as international - space organizations. The spectrum of our activities ranges from simple classroom presentations to 15,000-visitor space exhibitions, from expert reports for the Austrian Federal Ministry for Technology to space technology transfer activities for terrestrial applications.

In summary, the Austrian Space Forum is...

- a **volunteer space organization**, led by space professionals,
- focusing on space **research** (e.g. human-robotic Mars exploration) and **outreach/education**,
- an **independant** organisation funded via research projects, donations and outreach activities.

**We are the Austrian Space Network.**

[www.owf.org](http://www.owf.org)

[www.facebook.com/spaceforum](https://www.facebook.com/spaceforum)

[www.twitter.com/owf](https://www.twitter.com/owf)

[www.youtube.com/owf](https://www.youtube.com/owf)

## 5 EXPERIMENT DETAILS

### 5.1 Spacesuits

#### AOUDA.X SPACESUIT

#### -AUSTRIAN SPACE FORUM-



Image rights: ÖeWF/manfredlang Visuelle Kommunikation GmbH

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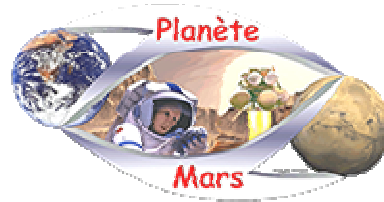
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- Aouda.X is a spacesuit simulator for planetary surface exploration, which the Austrian Space Forum has developed within the Mars analog research program „PolAres“. Aouda.X is able to mimic border conditions that a real Mars spacesuit would provide. The purpose of this spacesuit is to study contamination vectors in planetary exploration analog environments and create limitations depending on the pressure regime chosen for simulation.
- The outer hull consists of a Panox/Kevlar tissue with aluminum coating and the suit can perform within a tested temperature range from -100°C to +35°C.
- An advanced human-machine interface, a set of sensors and purpose designed software act as a local virtual assistant to the crewman. Aouda.X is designed to interact with other field components like rovers and various instruments.

## 5.2 Rovers

### CLIFF RECONNAISSANCE VEHICLE CRV

#### -PLANÈTE MARS ASSOCIATION-

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Cliffbot test in Morocco in 2013 during the Mars2013 ÖWF simulation (image rights ÖWF/Katja Zanella-Kux)

Cliffs provide access to layers telling the story of millions of years of geological, meteorological and possibly biological activity. One solution to explore such an area is to use a cable-suspended rover. Some artists' renderings show astronauts in space suits suspended on ropes along a vertical cliff on other planets. Such a difficult operation would only be attempted if a rover had discovered worthwhile features to explore the cliff, beforehand! Planète Mars Association decided in 2001 to assess the difficulties of mobility along a slope or cliff for such a cable-suspended rover. The Cliff Reconnaissance Vehicle (also dubbed "cliffbot") is not a "lightweight space-qualified" design but a prototype to test the best configurations for mobility. Cliffbot is currently operated manually. An operational vehicle would, in fact, be controlled by an electric winch. The typical Cliffbot payload is a camera but other payloads may be carried as well. Therefore varying payloads must be included in the upcoming field experiments on the glacier.

Three Cliffbot configurations have been tested in France as well as in Utah by the US Mars Society Simulation Habitat (MDRS). Eight Cliffbot campaigns were conducted at MDRS since 2002. A new campaign was conducted in the beginning of 2012 in the area of the Austrian Dachstein cave utilizing permanent ice structures. The Martian cave exploration simulation in Austria was organized by the ÖWF (Austrian Space Forum). One of the Cliffbot tests was conducted by an operator in the ÖWF spacesuit Aouda.X, who gently directed the Cliffbot over an ice cliff. Another Cliffbot was utilized in this campaign, carrying ground-penetrating radar developed by the LATMOS laboratory for the ExoMars European probe. An additional simulation was carried out in the northern Sahara deserts in Morocco in 2013, again organized by the ÖWF.

The AMADEE\_15 simulation will present new conditions for CRV testing, demonstrating hardware improvement as well as operations completed on high cliffs.

## PULI ROCKS

### Mobility Testing for the Hungarian GLXP Rover

#### -PULI SPACE TECHNOLOGIES-



Image rights: T. Pacher / Team Puli Space

#### Contact:

##### Project leader:

Dr. Tibor Pacher,  
GLXP Space Technologies, Hungary

[tibor.pacher@pulispace.com](mailto:tibor.pacher@pulispace.com)

The Puli is an unmanned, semi-autonomous, four “wheg” (wheel+leg) rover designed by the Hungarian Google Lunar X PRIZE (GLXP) contestant Puli Space in order to explore new worlds. During the AMADEE-15 field experiments, it aims to demonstrate its capability to be operated by remote mission control from Budapest and to test its reliability and moving capabilities on extreme, hard terrain. It is a prototype version of the rover which is planned to land on the Moon to win the Google Lunar X PRIZE competition.

Puli, whose namesake is a popular and intelligent Hungarian herding dog breed, shall also test its thermal and mechanical stability, the efficient and reliable communication between its subsystems, its power usage control, and solar panel charging characteristics of its batteries in the simulated extra-terrestrial environment. In addition, Puli will use stereo cameras as “eyes” to image its surroundings from which a 3D map will be generated by mission control to direct the rover's movement remotely. Autonomous rover behaviour scenarios shall also be tested by simulating emergency situations. Finally, the rover may carry other scientific instruments as well.

Puli Space Technologies Ltd is a Hungary-based company which develops solutions for a new era of commercial space exploration. Founded in 2010, the company now enjoys the support of a large group of voluntary professionals, an ever growing list of forward-thinking investors, and thousands of individual supporters.

[www.pulispace.com](http://www.pulispace.com)

[www.facebook.com/pulispace](https://www.facebook.com/pulispace)

<http://www.facebook.com/pulispace><http://www.googlelunaxprize.org/teams/team-puli>

[www.youtube.com/pulispace](https://www.youtube.com/pulispace)

[www.twitter.com/pulispace](https://www.twitter.com/pulispace)

The **Google Lunar X PRIZE** competition is the 21st century's race to the Moon. The X PRIZE foundation will reward teams from its 30 million dollar purse that are able to land a rover on the Moon by 2015 and perform given tasks including movement of more than 500m while transmitting back high quality pictures and near-real time videos to the Earth.

## 5.3 Life Sciences

### L.I.F.E.

**Laser-Induced Fluorescence Emission Application of a Novel Non-Invasive In-Situ Tool**

**-UNIVERSITY OF INNSBRUCK, INSTITUTE OF ECOLOGY-**

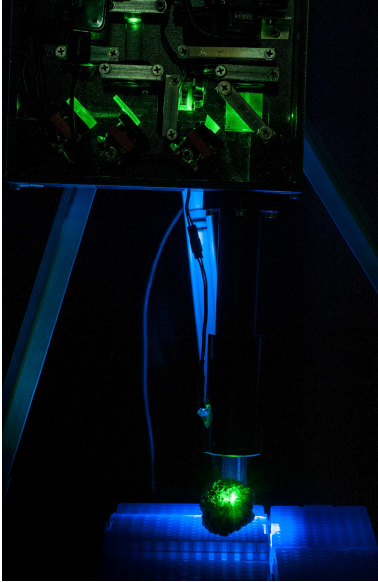


Image rights: Klemens Weisleitner



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The L.I.F.E instrument (Laser-induced Fluorescence Emission) is a portable non-invasive tool that is capable of detecting and quantifying biomarker molecules in extreme environments. It triggers fluorescence signals that can be captured and analyzed by the device. The instrument will be connected with the Aouda.X space suit. The analog astronaut performs measurements on the rock glacier, sends the raw data back to the mission control center in Innsbruck and collects the sample for further measurements. The final results can be evaluated within an hour.

## GLACIER-MASE

Glacier as Mars Analog site for microbial Space Exploration

-MEDICAL UNIVERSITY GRAZ, DEPARTMENT OF INTERNAL MEDICINE AND  
GERMAN AEROSPACE CENTER, GERMANY-



**MASE**  
Mars Analogues for Space Exploration



Deutsches Zentrum  
für Luft- und Raumfahrt



Medizinische Universität Graz



Image rights: Anna Auerbach

### Contact:

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Dr. Petra Rettberg

German Aerospace Center (DLR e.V.),  
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Group 'Astrobiology',

Is there life on Mars- and if so: what does it look like?

The European MASE team is interested in understanding the microbial life that thrives in Mars-similar sites on Earth. We want to understand, how microorganisms adapt to difficult environments, how they withstand extreme conditions, such as radiation, and how they deal with the lack of oxygen – like on Mars. We are currently analysing several Mars-similar habitats, including salt mines in the deep subsurface and permafrost regions. The Kaunertal-Gletscher will be another extreme site to be analysed for the life it harbours: under Mars mission simulation conditions we will have the chance to perform sampling and life-detection experiments in order to answer the questions, whether the glacier microorganisms are capable of surviving e.g. simulated radiation, as it occurs for example on Mars or other solar bodies. Within Glacier-MASE, we are bringing explorers and scientists together to add several new puzzle pieces to one of the most profound question of humankind: Are we alone?



## DENTAL TREATMENT ON MARS – MADE

Dental Treatment during a Human Mars Mission with remote support and advanced technology

-MEUSBURGER DENTAL TECHNIC AND SPACE-CRAFT ARCHITEKTUR-

spacecraft ARCHITEKTUR meusbürger dental,technik

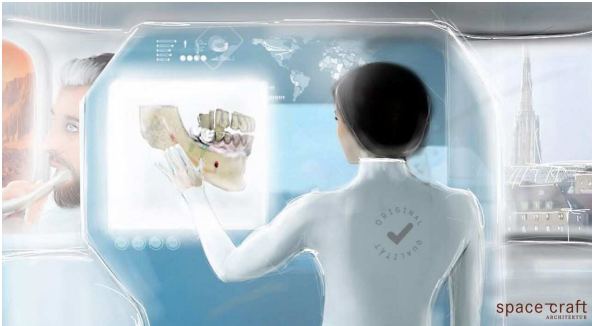


Image rights: Herwig Meusbürger

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**Project leader:** Dr. Sandra Häuplik-Meusbürger, space-craft Architektur, Parisergasse 4/2, 1010 Wien

0699-19413757

[shm@space-craft.at](mailto:shm@space-craft.at)

Health issues of astronauts are high priority issues on long-term missions. Medical equipment and instruments are available for a number of likely medical procedures. This is also valid for tooth ache. Today, in case of an emergency, pain can be suppressed until medical help (back on Earth) is available. In extreme emergency, tools are available to extract the tooth.

Although dental accident occurrences have been minimal so far, they are expected to rise significantly on long-term missions. However, contrary to Earth conditions, a dentist or dental technician will not be available.

This research project studies the technical feasibility of 3D Technology in combination with dental technology and presents a new field for human space flight.

During the AMADEE-15 mission we will demonstrate the workflow of a dental treatment with remote support. The technical procedure, including the process of detecting, diagnosing and treating a dental problem, will be simulated under 'Mars conditions' and results will be evaluated concerning future potential applications.

## 5.4 Engineering and Infrastructure

### VEMES

#### Virtualization Experiment for Mars Expedition Simulations

#### -MARS SOCIETY, ITALY-



Image rights: Adelmo Diamanti

**Contact:**

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Italian Mars Society

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The European Mars Analogue Station for Advanced Technologies Integration (ERAS) is a program spearheaded by the Italian Mars Society (IMS). Its main goal is to provide an effective test bed for field operation studies in preparation for manned missions to Mars.

Preliminarily to its construction, IMS has started the development of an immersive Virtual Reality (VR) simulation of the ERAS Station (V-ERAS). The major advantage of such virtualization is that it will be possible to undertake training sessions with a crew that can interact with its future environment before the actual station is built. This way a more effective design of the station and associated missions and a strong reduction of costs could be obtained. The main objective of this activity will be the achievement of adequate fidelity simulations and validation of the data obtained during the training sessions so that they can be used for the design of the station itself.

During AMADEE-15 the capabilities of a virtual reality system to support extra vehicular activities both on-site and in the mission support center will be assessed.

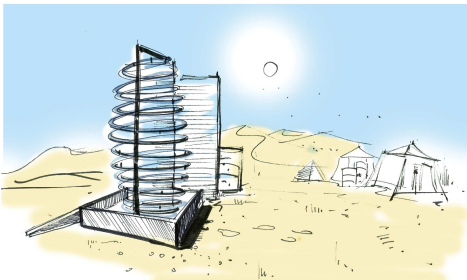
**Mobile water fog shower suitcase with a low water consumption****-OBRAM S.A., POLAND-****Contact:****Project leader:** Krzysztof Jędrzejak  
Co-founder & MarketingEmail: [k.jedrzejak@proxim-solutions.com](mailto:k.jedrzejak@proxim-solutions.com)  
tel: +48 662 291 719

Image rights: Krzysztof Jędrzejak

PROXiM is a young designing office striving to create innovative products and services based on deep understanding of the problems and needs of users, whilst combining the visual aspect of the solution itself as well. In contrast to similar companies we connect functional and attractive design with innovative and unprecedented technical solutions.

PROXiM was founded in January 2014 in Warsaw, by Jakub Falaciński, Wojciech Kowalik and Krzysztof Jędrzejak.

Our first and flagship project is the FOG, foldable shower stall using water fog. The result is a shower that consumes only 450 ml of water per minute of use.

Thanks to the lightweight construction, also a mobile version of the solution and its use in places with very small quantities of fresh water is possible. Moreover, the solution is ideal for home bathrooms - even those with very small cubature.

After the successfully ended tests, we plan to create a model that allows washing in a state of weightlessness using fog shower. Until then, we want to implement the fog shower until the end of 2016 on the European and American market.

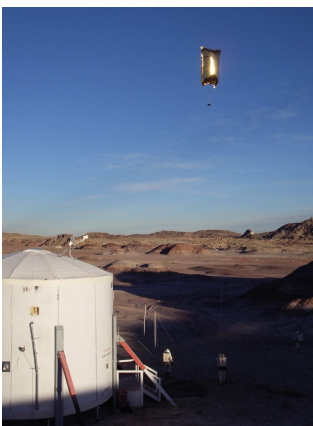
**-PLANÈTE MARS ASSOCIATION-****Balloon Carried Camera**

Image rights: APM/ J. Geoffray

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Astronauts in exploration on Mars could benefit of terrain views taken by a camera carried above them by a balloon. In walking operations the balloon is tied by a rope to the spacesuit. Pictures may be used for direct video transmission and also to map the path followed by the astronauts, as well as to document the operations conducted or, for example, the surroundings of collected samples.

## 5.5 Geosciences

### GPRoG

#### Ground Penetrating Radar on Glaciers

-UNIVERSITY OF ATHENS, DEPARTMENT OF GEOPHYSICS AND SEISMOLOGY, GREECE-



National Kapodistrian  
University of Athens



Image rights: Alexandra Zavitsanou

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University of Athens

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email: [azavits0@gmail.com](mailto:azavits0@gmail.com)

On Mars, landforms such as lobate debris aprons, concentric crater fill and lineated valley fill are strongly connected to glaciers. These landforms may be regarded as reservoirs of stored water ice. Stored water ice is a very important research field since it could provide a better understanding of the geological history of the planet, indicate the possibility of past life and finally, it could be used as fuel source for human exploration. Ground penetrating radar (GPR) is a well-suited technique on glaciers providing descriptions of their internal structure and development and therefore ice distribution inside them.

GPR is a well-established technique for subsurface investigation. This non-invasive technique uses electromagnetic waves to image the subsurface. A GPR system includes a signal generator, transmitting and receiver antenna, as well as a control unit having digital recording facilities. Pulses radiated from the antenna are reflected from various interfaces delimiting media of different dielectric properties, then gathered by the receiver antenna and finally recorded/stored.

Simulating a GPR prospecting on Mars using a terrestrial glacier analogue will give us the opportunity, primarily, to check and ensure whether this geophysical operation can be conducted smoothly under particular conditions. These conditions are referred to the fact that the user is in a spacesuit simulator, walking on the possibly rough terrain of a rock glacier, while operating the GPR instrument. Data acquisition will be performed by the astronaut along specified traverses oriented parallel and perpendicular to glacier flow direction. This procedure will result in a grid of data of which valuable information is expected to be extracted including bedrock topography mapping, ice thickness and glacier volume determination and water resources detection.

## LICHEN

### Relative Dating of Moraines

-UNIVERSITY OF WARSHAW, POLAND-



Yellow-green *Rhizocarpon* lichen

Schmidt hammer in action

Image rights: Dr. Maciej Dąbski, Faculty of Geography and Regional Studies, University of Warsaw

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Lichenometry and the Schmidt hammer are used by glacial geologists to obtain information on the relative age of moraines. After glacial retreat, lichens gradually colonise freshly exposed rocks and weathering processes start to operate. This results in a decrease of the rock strength which is recorded by a lower rebound value (R-values) of the hammer. Therefore, the larger lichen thalli are and the lower the R-values, the older is the landform. If the rate of lichen growth is known, the absolute age can also be calculated. However, the lichen growth rate and rock surface deterioration depend also on microclimatic conditions (e.g. aspect of the rock surface, available moisture) and the type of rock (petrography). Furthermore, R-values can differ depending on the size of a stone, its internal structures (e.g. existing fissures or voids), and surface microrelief (smooth or irregular). However, if mentioned factors are controlled, the application of these methods is relatively easy, quick and cost-efficient. A lot of reading can be obtained in a short time allowing for statistically significant results.

During the AMADEE-15 Mission the analogue astronauts will exercise these methods across a moraine ridge of the Kaunertal glacier. They will measure *Rhizocarpon* lichen diameters and read the Schmidt hammer R-values from any suitable rock surface along a designated profile running from the stoss-side of the landform to its lee-side and register information regarding petrography of each stone and aspect of rock surfaces.



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## WoRIS

### Weathering of Rocks at the Ice Surface

**-POLISH ACADEMY OF SCIENCES AND ÖWF RSS (REMOTE SCIENCE SUPPORT)-**

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Weathering within ice has been recently proposed as one of the most important geologic processes active currently on the surface of Mars. During the AMADEE mission we will perform a field experiment to determine influence of albedo and emissivity of the objects laying on the surface of glacier on the rate cryoconite holes formation and development. This study will help to better understand factors influencing the rate of melting of terrestrial glaciers, and the process of weathering on the current Mars.



## Supporting the AMADEE-15 Mission:

### Kaunertaler Gletscher Opens your mind!



It takes 26 kilometres to get from the little village Feichten up to the Kaunertal Glacier at an altitude of 2.750 m above sea-level. A gondola will take you even higher. At the so called „Drei-Länder Blick“ at 3.108 m there will be a breathtaking view over the massive Alps with their white glaciers on top. From this platform you will see peaks in Austria, Italy and Switzerland.

On a clear day the horizon seems to be endless and it feels like the sun can be reached with your hands. Ideal preconditions to do the next step: Start into space!

The Austrian Space Forum OeWF did not choose the Kaunertal Gletscher because it is so close to Mars, but because the landscape formed by the glacier gets close to what is expected out there. As beautiful the countryside at this altitude is for visitors, as hard and inhospitable it can be. And that is exactly what the OeWF is looking for testing their Mars-Mobiles and other technical equipment.

At the same time a modern ski-area like the one in Kaunertal offers a technical surrounding which makes things easier for such a test field. The man-power of the ski area usually is in charge to prepare slopes, explodes avalanches and keeps lift-systems working, to make a ski holiday safe and to be a pleasure. With their technical knowledge and familiarity with the geographical situation on the mountain the team will support the test field staff wherever they can.

For the OeWF-team this will be an exciting field research up in the mountains. For visitors of the Kaunertal this will be another reason to make their way up there to see how such a scientific work is done. Not only then the visitor's horizon will be opened. There is the view from a mountain as mentioned above. On the other hand everybody can have a look into the past exploring the landscape formed by the glacier. One of those natural monuments – the glacial pothole – can be seen as well as a block glacier and even a step into the glacier can be done. A path through a crevasse will give you a nice cooling on a warm summer day.

In summer you may open your mind by finding new plants or animals (e.g. alpine marmot) you have never seen before. In winter you may explore your own body by skiing down one of the slopes, jump through the snowpark on your board or go freeriding off piste.

One thing is for sure: The Kaunertal Gletscher will open your mind in several ways!

Further information on [www.kaunertaler-gletscher.at](http://www.kaunertaler-gletscher.at)



Fotos: Kaunertaler Gletscher

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**DAS VERBINDET UNS.**

## **Press release**

Vienna/Innsbruck, August 2015

### **Mars Simulation: Safely en route with LTE from T-Mobile**

- Mars-Event at the end of July 2015 in „Sand in the City“ in Vienna
- With the help of Oculus Rift and LTE, T-Mobile lets you experience Mars
- T-Mobile sent the winners to a Mars simulation to a glacier

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Whilst a future Mars expedition of NASA is currently not on the radar, Austrian and international “Marstronauts” are landing on August 3, 2015, on the Tyrolian Kaunertaler glacier. After simulated Mars expeditions in the Spanish and Moroccan desert, the Austrian Space Forum now demonstrates its expertise in aerospace in alpine conditions. Ever since 2011 T-Mobile has been the official technology partner of the Austrian Space Forum supplying the Mission Support Center in Innsbruck with LTE.

LTE proves its high broadband quality, with which essential and critical data for astronauts can be safely transmitted.

#### **Sensitive data transmitted via LTE**

LTE (Long Term Evolution) enables data rates of up to 150 megabit per second, ideal for the Mission Support Center of the ÖWF in Innsbruck, which transfers huge amounts of data (eg. Video-streams, bio-medical telemetry data from spacesuits, performance data from robotic vehicles, ...). „We are very glad to support the team of scientists and aerospace enthusiasts with our LTE technology during such a visionary mission. The Austrian Space Forum was one of the first users in 2011 of the fourth generation of mobile telecommunications technology

before its official launch. Because of our LTE network, highly sensitive data can be transmitted reliably, fast and cost efficient from the Mission Support Center around the globe. A fast and precise transfer and a short latency are vital for a successful Mars Mission“, says Rüdiger Köster, CTO T-Mobile Austria.

### **#SimulateMars in Vienna**

Before the two week Mars simulation on the Kaunertaler glacier, T-Mobile organized an extraordinary event on July 24 and 25, 2015 in the Viennese event location „Sand in the City“.

For the first time in Austria, an Oculus Rift (SDK2) was demonstrated. During this „Mars Event“ visitors could assimilate what the body of an astronaut experiences. With the help of Virtual Reality Systems (VERAS 3d Motivity Station Systems), an LTE connection and the support of technicians and astronauts, visitors experienced how mobile communications, aerospace and science are interconnected.

### **Experience Mars scenery and a Mars Habitat with Oculus Rift**

Through the use of an Oculus Rift (SDK2), a matt, a rack, parts of the exoskeleton and the training version of a glove of the spacesuit simulator Aouda, which will be used at the Kaunertaler glacier, testers experienced the restrictions a pressure suit used in space, has on the body. The scenery of Mars and a Mars habitat were simulated for future Mars explorers. The highlight of the six minute simulation was for the participants to experience the gravity ( $3,72 \text{ m/s}^2$ ) measured on Mars. After the event VERAS was prepared for the AMADEE-15 Mars simulation and transported to Tyrol. Photo material can be found here: <http://newsroom.t-mobile.at>.

### **T-Mobile Austria GmbH**

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