Humans on "Mars"

Results of the Austrian Multinational Mars Landing Simulation in the Northern Sahara

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MARS today
- -70 °C, 6-11 mBar
- 10 µm of precipitable water
- Chemically reactive surface

MARS 3.5 Gyrs ago
- probably warmer, >1 Bar
- oceans and lakes
- effective radiation shielding
PolAres research programme

- Passepartout stratospheric ballon
- Phileas rover
- Aouda spacesuit simulator

**Goal:** preparing exploration strategies for a human-robotic Mars expedition with a focus on planetary protection.

- *PolAres reference mission architecture*
Aouda.X spacesuit simulator prototype

- Based upon NASA DRM 5.0 & Aurora
  NASA Human-System Standard STD-3000 & MIL-STD-882c

- <45 kg, unpressurized, Hard-Upper Torso, custom-built OBDH and advanced human-machine-interface

- Outer layer optimized for planetary protection, 4-6 hours field operations

- Broadband telemetry

Previous system integration field tests

- Field-Test 1 – Commissioning - July 2009, Kramsach, Austria
- Field-Test 2 - Pasterze-Glacier, August 2009, Austria
- Field-Test 3 - Cryo-Test, September 2009, Seefeld, Austria
- Field-Test 4 – Eifel-region, September 2009, Germany
- Field-Test 5 – Koppenbrueller-Cave, January 2010, Austria
- Field-Test 6 - Innsbruck, May 2010, Austria
- Field-Test 7 – Kaunertal Glacier, July 2010, Austria
- Field-Test 8 – Rio Tinto Integrated Sim, April 2011, Spain
- Field-Test 9 – Dachstein Ice Caves, May 2012, Austria
Precursor Field Tests

International Mars Simulation
In Rio Tinto/Spain 2011

Focus:
• Human robotic interaction
• Geoscience & Remote Science Support
Dachstein Ice Caves
Subsurface field tests in Austria, 2012

Remote Science Support
Terrain Trafficability tests & Robotics
Contamination vector analysis
Ground validation of EXOMARS instrument
Precursor site assessments

- Geological analysis, precursor sampling
- Safety/Security/Logistics analysis
- Erfoud/Morocco region exhibits topographical and geological similarities to Martian surface features
Context Maps:
Prepared before the mission utilizing Mars-analog data sets

“Blinding of science and flight planning team”

Satellite overview map
(Landsat 7, 30m resolution)

Slope inclination map
(ASTER GDEM, 30m resolution)
**Basic Maps:**
Prepared before the mission, regularly updated during the mission

**Legend**
- Basement Units
  - Green: Layered Unit
  - Cones Units
    - Black: Cones Unit
  - Surficial Units
    - Light Yellow: Aeolian Sand Unit
    - Yellow: Dunes Unit
    - Light Blue: Young Channel Unit
    - Brown: Alluvial/Colluvial Unit
    - Red: Alluvial Fans
    - Tan: Colluvial Unit
    - White: White-tonned Unit

**Geological Map**

**Terrain Risc Map**

**Suitability Map** (example: SREC-Experiment)

**Wifi Coverage Map**
Training of a new group of analog astronauts

More than 100 volunteers from 23 Nations

The Flight Planning allowed for a flexible remote science support
Field operations ("OPS")

Field crew & experiments

Satellite link

Remote Sci. Teams/Public

Mission Support Center
Mission Experiment Highlights
MAGMA / L.I.F.E.-Laser
Robotic vehicle of ABM Space/Poland
Instrument: Bioflourescence laser (Univ. of Innsbruck/Austria)

Controlled from Torun/Poland
Cliff Recon Vehicle
(Association Planete Mars, France)

Human-operated vehicle for steep terrain
High-resolution imagery
PULI Rover (GLXP Hungary)
Autonomous (lunar) rover
Terrain & teleoperation tests
Deployable Shelter
(TU Vienna / OeWF)
Inflatable/pressurizable shelter
Proof-of-concept study
Hunveyor Station
(Eötvös Loránd University, Hungary)

An automated environmental station
microEVA
(NASA/JPL-OeWF)
Quantifying contamination vectors for planetary protection

Epiflourescence pattern with contaminated surface under excitation.
Selected results

Despite limitations of high-fidelity analog research and without prior knowledge of site, previous water activity was identified.

“potential biological activity“ 300 Myrs ago.

Measurement of work speed suited vs unsuited: 1.3-fold

Thermal inertia measurements as a field method for detecting cave entrances

Three robotic vehicles, two suits & deployable shelter successfully tested

Risc assessment of actual injuires: MSC vs field crew: w.r.t. traumatic injuries 1:4
Mission data from all major OeWF Analog Missions are public under mission.oewf.org/archive.
SUMMARY

MARS2013 was a complex Mars analog simulation in 2013, results will be published in a special edition of ASTROBIOLOGY.

It is considered as a precursor for an arctic expedition in 2016+ in the Canadian Arctic.

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