OPERATIONAL ISSUES FOR GEOLOGICAL ANALOG SIMULATION AT EIFEL VOLCANIC REGION: ILEWG EUROMOONMARS M . Harasymczuk[1,2,3], B. H. Foing[1,2,3], A. Kołodziejczyk[1], H.Vos[1,2,3], M. Krainski[1], L. Davidová[4,5], M. Mirino[1], A. Casini[6], & Eifel ILEWG EuroMoonMars 2016 support team* .,
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Introduction: Analog simulations has a very important role in preparation for space agencies to exploration of another celestial bodies. The main objective is to test procedures, tools and equipment for future use in those cutting-edge projects. As of the Extravehicular Activity (EVA) is the most crucial part of the mission and in fact this is the reason why we are sending humans for extraterrestial voyages we need to put a lot of efforts on communication, timelines, checklists and astronaut training itself.

During the EVA simulations performed in Eifel, Germany region the set of European Space Agency & ILEWG scientists and research collaborators has tested the human-robotic partnersip, EVA procedures and schedule for geological sampling of the sedimentary layers in former volcanic activity location.

Identification of the location in Eifel region

The simulation took place in Eifel volcanic region in the vicincy of Mendig, Germany (as latest of ILEWG EuroMoonMars campaigns [0 - 9]). The place has been chosen because of the past volcanic activity and rich and yet easy to access sedimentary layers of the geologic samples. The simulation crew has identified two distinct locations that were representative examples to test the human-robotic interactions together with geologic Extravehicular Activity procedures. Professionaly trained geologists had chosen suitable place to conduct the analog as soon as the crew arrived at the location of the simulation. During the simulation the crew prepared three distinct Extravehicular Activities. Each one of them had different objectives.

The first EVA

During the first EVA the main objective was to set-up a remote controlled telescope which was later used to identify interesting and note-worthy objects. Before the first simulation the analog astronaut crew started to prepare for the EVA. In the mean time the engineering crew prepared the lander and remote controlled rover for the deployment and simulated descent and landing on the ground. During the first Extravehicular Activity crew members tasks was:

- identify and take the contingency sample,
- establish and test the radio communication with simple and complex transmission,
- map the vicincy of lander for possible radio communication porblems,
- photograph the location of rover and nearby rock wall,
- secure the lander,
- check the wireless connection of the computer systems between lander and habitat,
- setup and calibrate the spectrometry analysis device,
- photograph the location of soil and rock sampling
- identify and sample the most interesting elements of the sedimentary layer,
- photograph wtih high precision the rock to outcrop,
- outcrop rock samples and collect in plastic bags, photograph and mark the bags,
- test possibility of the rover to access the rough terrain,
- deliver the rock samples using the rover to the spectrometry analysis device on lander,
- conduct spectrometry analysis from hebitat using remote control

Figure 1, Two astronauts and the ILEWG ExoGeoLab lander during an analogue Moon EVA.

The second EVA

The second EVA main objective was to secure lander access to the power using solar panels and to do geological field work. Moreover the team had to perform:

- investigate more in-depth details of the sedimentary layers,
- photograph with high resolution camera the field of work,
- outcrop and collect to marked bags the rock samples,
- identify more detailed location for future EVA,
- test the suit for easy of move,
- test the emergency procedure for EVA termination because of solar flare coming.

The Third EVA

Third EVA's main objective was to test rover possibility to perform tasks in extremaly rough terrain and for

the astronaut Biologist to take ground sample to identify signs of life. This EVA has been performed in the dim light conditions with the limited visibility.

- test rover operations in rough terrain,
- identify and collect biological sample for further analysis,
- test the rover lights,
- test the influence of poor lightning condition on rover control using video navigation aids,
- test in-the-field rover control using portable antenna and sidearm joystick,
- test radio communication procedures.

Identified issues

During EVA scenarios team was able to identify several issues. Most of those issues were connected with communication and mission organization. The problems has been reported and elaborated upon to create a lessons learned article. Here's the list of the improvements astronauts team must introduce before the next simulation.

Communication

- train astronauts with radio communication,
- introduce common linguo and alphabet,
- pre-established radio callsigns and callouts,
- establish protocol for emergency calls,
- introduce radio communication culture,
- introduce protocol for lost communication,
- train crew to communicate intentions befor activity,
- simplify the emergency procedures,
- investigate problems with radio communication hardware.

Mission Organization lessons

- improve EVA scenarios,
- make more clear the general mission objectives,
- train more people in lander &onboard hardware assembly,
- inventory system & keep your workspace clean culture
- prevent chaos spontanously happening,
- ihave segregated compartments with tools &spare parts,
- log EVA events, timelines, informations,
- keep more organized notes or use IT system support,
- introduce briefings and debriefing.

Extravehicular Activity lessons

- create a pre-EVA checklist: rock hammer, sample bags, size comparison marker, suit stuff, lightning,
- create a procedure for taking pre- and post-EVA medical measurements,
- maintain in-habitat culture while EVA is in progress,
- shorten the pre-EVA procedure,
- introduce work in pairs (leading EV1 and supporting EV2),
- document in more detailed manner the field and sample before performing a tasks,
- keep order in things and place things up in proper places,
- introduce on sleave checklist,
- introduce event logging for the habitat crew.

Wrap-up session

After the simulation crew has been participating in the wrap-up session, in which the following talks were delivered:

- Status Moon Village activities update (B. Foing)
- Spaceship EAC update (A. Cowley)
- MoonMars Base Simulation (A Kolodziejczyk)
- 1year at HiSeas Mars and MAMBA MoonMarsBase project (C. Heinicke)
- MoonWalk (I. Schlacht/J.Rittweger/Can Inellioglu)
- Lunar EVA simulations (M. Harasymczuk)
- MoonMars Simulation Psychology studies (L. Davidova)
- Material and 3D printing studies (EAC)
- Collecting and analysing samples with robots and astronauts (M. Mirino)
- MoonMars analogue sample spectro demo (H. Vos)
- Virtual reality Model study of lunar polar illumination (A. Casini)
- TeleRobotics (M. Krainski)
- Virtual Reality Simulation Game at MoonVillage (E. Tomozei)
- presentation by Spaceship EAC students
- report from ESTEC workshop & Eifel field study

*We thank the participants and collaborators for the ILEWG EuroMoonMars Dec 2016 campaign at the Eifel.

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