

## ***EuroMoonMars 2018 Workshop: Lunar Analogue Simulations.***

Elise Clavé (1,2,3), Louis C. Dubois (1,2,3), Bernard H. Foing (1,2) Germaine van der Sanden (1,2), M. Krainski, M. Grulich, A. Sitnikova, I. Cinelli, A. Zaklinsky, Y. Akisheva, B. de Winter, J. Rodrigues, D. Michalik, M. Ijzerman, A. Izotova, I. Andersson

(1) ESA-ESTEC, Noordwijk, the Netherlands, (2) ILEWG, Noordwijk, the Netherlands, (3) ISAE-Supaero, Toulouse, France (eliseclave96@gmail.com)

### **1. Introduction**

On the 19<sup>th</sup> and 20<sup>th</sup> of April 2018, the International Lunar Exploration Working Group (ILEWG) and ESA-ESTEC held the annual *EuroMoonMars* Workshop and gathered speakers and participants involved or interested in the Moon-Mars Villages topic. On the second day of the workshop, we ran two Lunar Analogue simulations. Three teams were involved: two crews and the Ground Control Center (GCC).

### **2. Objectives of the simulations**

Terrestrial simulations offer great insight into what it takes the human species to inhabit Space.

The first simulation was result oriented, to demonstrate the functioning of different technologies on the ExoGeoLab lander (robotic test bench) and in the ExoHabitat (Hab). The second simulation was to allow attendees to discover the concept of analogue simulations or train them for other campaigns.

### **3. Preparation of the simulations**

The team spent some time preparing detailed procedures and schedules for the different activities and tests to be ran during the simulations, to allow analogue astronauts to perform their tasks with as much autonomy as possible. Astronauts could also train in the handling of the equipment and the communication protocols on the first day of the workshop, during a session of technical demonstrations and master classes.

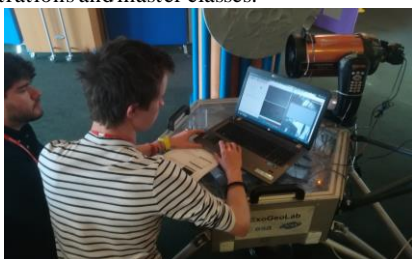


Figure 1 - Attendees learning to control ExoGeoLab lander remotely

### **4. The facilities**

The simulations took place in the EuroMoonMars facilities at ESTEC: the Habitat module called ExoHab and the laboratory module: the Exobiology Laboratory (ExoLab). The activities in the former were more technology oriented whereas in the latter, they were more about science (biology, human health etc.).



Figure 2 -ExoHabitat with origami tunnel

### **5. ExoHabitat**

In the ExoHabitat, there were three crewmembers in the morning simulation and four in the afternoon one: the Hab Commander, the Scientific Officer, the Engineer and the Journalist. The Hab Commander was in charge of communication with the Ground Control Center, controlled the lander remotely and ran some spectroscopic analysis. The Scientific Officer and Engineer performed Extra Vehicular Activities (EVAs) such as exploring and sample collecting. The Journalist was in charge of uploading the logbook during the mission and record important events. During the first simulation, the astronauts accidentally introduced a few changes in scenario and not all planned activities were successfully ran. However, the lander was successfully set up, astronauts performed remote control to carry out visual check-up of the facilities and monitor EVAs. Because of the unplanned changes in the scenario, they also performed other tasks, such as detailed spectro-



analysis of the collected samples or sky- and satellite-surveillance.



Figure 3 - ExoHabitat astronauts on Extra Vehicular Activity, checking on ExoGeoLab lander

The second simulation went very smoothly and the different tests were successfully implemented.

## 6. ExoLaboratory

The Lab Commander, the Scientific Officer, Biomedical Engineer, Food Designer and the Visual Artist constituted the crew of the ExoLaboratory. The crew ran different experiments in the Lab and in Extra Vehicular activities such as a study of the growth of plant in Martian-like environment, a demonstration of guided medical assistance during emergency in EVA.



Figure 4 - ExoLaboratory crew running different tests

The first simulation went very well, except for a slight problem with communication: communications with the Ground Control Center and the astronauts on EVA were on the same device, and therefore in case of emergency, the

Lab could not let GCC know as the same time as guiding astronauts on EVA through what to do.

During the second simulation, an important communication problem occurred and the Lab crew has been out of the waves for a significant duration. This event led to interesting situations of emergency, and forced participants involved in GCC and ExoHab to build up and carry out urgent rescue missions. These missions resulted eventually in a recover for the ExoLaboratory of the communications. In the meantime, the crew had very efficiently followed the schedule and performed their tasks.



Figure 5 - Sketch of lab crew during second simulation by Anastasia Izotova, Visual Artist of the second crew

## Acknowledgements:

We would like to thank the International Lunar Exploration Working Group (ILEWG) and acknowledge the analogue astronauts who participated in the simulations: Maria Grulich, Anna Sitnikova, Ilaria Cinelli, Alexander Zaklinsky, Yulia Akisheva, Bram de Winter and Jocelino Rodrigues, Daniel Michalik, Mark Ijzerman, Anastasia Izotova and Isa Andersson. We would also like to thank those who got involved in the Ground Control Center, Csaba Jeger and Hugo Schravessande particularly.

## References

- [1] Foing, B.H. et al ILEWG EuroMoonMars: Research Technology and Field Simulation Campaign [2017LPICo2041.5073F](#)
- [2] Foing, B.H., Stoker, C., Ehrenfreund, P.: Astrobiology field research in Moon/Mars analogue environments, [2011IJAsB..10.137F](#)
- [3] Foing, B.H, Orgel, C., Stoker, C. et al: Gale Crater Analogue Geology Studies at Multiple Scales [2014LPICo1791.1462F](#)