EMMPOL (Euro Moon Mars POLand) Moon analog mission. I. R. Perrier[1], B. Foing[2], A. Kołodziejczyk[3], K. Komenda[3], M. Clain[1], E. Forgues - Mayet[1] , T.Podolsky[1], J. Bardin-Codine[1], H. Castaing[1], Q. Gouault, R. Landolina[2]
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As a part of the general ambition of reaching the Moon and in particular to support the preparation of Artemis missions, or part of the support teams, IPSA (Institut Polytechnique des Sciences Avancées) Air and Space Engineering School in France joined the ILEWG Euro Moon Mars programme. The ILEWG EuroMoonMars programme includes research activities for data analysis, instruments tests and development, field tests in MoonMars analogue, pilot projects , training and hands-on workshops , and outreach activities. EuroMoonMars field campaigns have been organised in specific locations of technical, scientific and exploration interest. Field tests have been conducted in ESTEC, EAC, at Utah MDRS station, Eifel, Rio Tinto, Iceland, La Reunion, LunAres base at Pila Poland [1-10], and HiSEas base in Hawaii, and AATC Poland (EMMPOL)

Our first EMMPOL missions together were focused on studies of the habitability conditions on the Moon and on conducting experiments in lunar simulation habitat, supported remotely by a mission control team and science support .

The Analog Astronaut Training Center facility in Poland allowed us to test our experiments in an isolation campaign of one week in October 2020. We shall describe the preliminary results from EMMPOL1 crew campaign, and lessons learned for ARTEMIS mission control and science support.

Projects and experiments: As part of the project - based learning our students worked on the future habitability conditions on our natural satellite, and performed a set of experiments, that were also monitored form Mission control and science support. This included:

Hydroponics A greenhouse concept was developed. All the technical aspects were studied: design, automatic systems, energy budget, but not only. A greenhouse is meant to allow humans on the Moon to have a certain autonomy in growing plants and vegetables, in order to have fresh food and a good nutrient supply. This project allowed us to get familiarized with aquaponics and hydroponics technics, for fish and plants. Concerning the Hydroponic system we propose an improved biofilter with an increased nesting surface meaning an increased surface for nitrifying bacteria .

High pH water studies. We know that water is a key element for our survival. Long-term space missions are challenging when thinking about water budget, its source and its quality. Hydration is important for humans but necessary for plants too. AquaVia 9.4 pH commercialized water was tested during our isolation campaign. It was compared with neutral pH water impact on the growth of plants but also on the human body. Analog astronauts followed a special diet in order to clearly identify the action of the alkaline water.

Life support system. Algae are the most widespread oxygen producers in the world. They are also resistant to environmental changes, easy to breed and they effectively reduce CO2. In confined and small spaces, the increased amount of CO2 generates a potential risk for the crew [1]. Three types of microalgae consortia were used in the experiment. Arthrospira plantita, Chlorella, Spirulina, Synechocystis spp. were the most dominant algae species selected for this study. The efficiency of CO2 reduction was investigated as a function of time by placing algae consortia in chambers of various volumes in a sealed container. The algae were saturated with the external habitat air rich in CO2. The risks were characterized and costs related with implementation of this biological method.

Recycling. The recycling awareness came in very naturally. Our daily production of wastes increases and the types of materials we are using is evolving; Thanks to the collaboration with a French environmental friendly association called Zeapack, we could test compost done with recyclable plastic. Laboratory items like plastic gloves and plastic bags were utilized for the study using the Berkley method.

Sample return 3D printed spacecraft . Once humanity will have access to a lunar base, it is likely that we will need a spacecraft to send samples or equipment back into orbit or Earth. To cope with that, we created a micro launcher which is a 3D plastic printed rocket with a purpose of sending moon regolith sample in orbit or to earth. It is composed of three parts: the thruster, the tank and the payload. The main goal was to design a launcher versatile and adaptable to lots of purpose. Being able to 3D print a launcher directly on the Moon base with inexpensive material as plastic, would allow to decrease the complexity and the price of returning samples, such as experiment results, to Earth.

Here we illustrate the schedule of science, technical, physical and social activities that were monitored from mission control and science support team.

Mission control and science support

Time	Commander ROXANA	VICE-Commander KRYSTIAN	Communication Officer THEO	Astrobiologist EMMA	Data Officer MIKAEL
	7:00 Medical check in: STP (sleeping report, subjective time perception TEST 4.1.1.3), Urine volume, Body weight, temperature, blood pressure, pulsoximetry				
	body temperature 08:00 Zeitgeber 0 [ZT0]. ***Note : write values like 34,5 instead 34.5***				
	08:10 to 08:50 - Sudoku Test (4.5.4.1)	08:10 to 08:50 - Sudoku Test (4.5.4.1)	08:10 to 08:50 - Sudoku Test (4.5.4.1)	08:00 - 09:00 Physical workout/ Medical check in before and after (temperature, blood pressure, heart rate, pulsoximetry)	08:10 to 08:50 - Sudoku Test (4.5.4.1)
	Breakfast 09:00 - 10:00 combined with a briefing, IR exposure				
	body temperature 10:00 [ZT2]. ***Note : write values like 34,5 instead 34.5***				
	10:10 to 11:00 - Treadmill test and subjective time perception Procedure 4.5.4.2	10:10 to 11:00 - Treadmill test and subjective time perception Procedure 4.5.4.2	Brefing MCC	10:10 to 11:00 - Space Weather Report	10:10 to 11:00 - Treadmill test and subjective time perception Procedure 4.5.4.2
		11:00 to 12:00 - Physical workout/ Medical check in before and after (temperature, blood pressure, heart rate, pulsoximetry)	11:10 to 12:30 - Micro launcher		11:10 to 12:30 - NAWOT
				12:00 to 12:30 - Sudoku Test (4.5.4.1)	
	12:40 to 13:00 : RTT & MMT	12:40 to 13:00 : RTT & MMT	12:40 to 13:00 : RTT & MMT	12:40 to 13:00 : RTT & MMT	12:40 to 13:00 : RTT & MMT
	RTT Test - Follow the instructions in the manual (4.1.4). Before lunch	RTT Test - Follow the instructions in the manual (4.1.4). Before lunch	RTT Test - Follow the instructions in the manual (4.1.4). Before lunch	RTT Test - Follow the instructions in the manual (4.1.4). Before lunch	RTT Test - Follow the instructions in the manual (4.1.4). Before lunch
	Memory Test - Complete the file "MT Day 05 Lunch" on Google Drive. Before Lunch	Memory Test - Complete the file "MT Day 05 Lunch" on Google Drive. Before Lunch	Memory Test - Complete the file "MT Day 05 Lunch" on Google Drive. Before Lunch	Memory Test - Complete the file "MT Day 05 Lunch" on Google Drive. Before Lunch	Memory Test - Complete the file "MT Day 05 Lunch" on Google Drive. Before Lunch
	Lunch 13:00-14:00 IR exposure				

Acknowledgments:
Zeapack Vaisselle Ecologique, 34690 Fabregues, France.

AquaVia naturally alkaline spring water pH 9.4, Transilvania - Bologa, Cluj county, Romania.

Zortrax Poland https://zortrax.com/

Euro Moon Mars/ILEWG
AATC Analog Astronaut Training Center https://www.astronaut.center/

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