

IAF SPACE EXPLORATION SYMPOSIUM (A3)  
Moon Exploration – Part 3 (2C)

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ADVANCING ANALOG ASTRONAUT TRAINING AND LUNAR HABITAT RESEARCH: INSIGHTS  
FROM EURO MOON MARS MISSION**Abstract**

The EuroMoonMars program is dedicated to advancing our understanding of lunar and Martian environments through various research activities, including data analysis, instrument development, field tests in Moon Mars analogs, pilot projects, training sessions, workshops, and outreach initiatives. Central to the program is the evaluation of habitability conditions on the Moon and experiments conducted within simulated lunar habitats. Remote support from a mission control team and scientific experts, facilitated by the Analog Astronaut Training Center in Poland, aids in these endeavors. The EMMPOL17 campaign, located approximately 120 km from Krakow, Poland, at the Rezwiennik Habitat, marked a significant milestone in enhancing research within simulated lunar environments. During this campaign, an international, interdisciplinary crew conducted diverse experiments, including investigations into human stress, health, biocontamination in isolation, aquaponics systems, and energy recovery.

**Optimization of Aquaponics Systems:** This experiment aimed to enhance system autonomy through sensor integration, allowing remote monitoring and adjustment of crucial parameters such as temperature, pH levels, and water levels.

**COMET (COil Mechanical and Electric Transducer):** This mechanical energy recovery system comprised two devices to harness mechanical energies within the base. One device captured energy generated during exercise using a dynamo, while the other utilized piezoelectric sensors in gel soles to convert mechanical energy into electricity stored in batteries attached to astronauts' ankles.

**TEC (Thermodynamic Energy Conversion):** Leveraging the Seebeck effect, this experiment aimed to unlock the potential of heat energy within the lunar base. By identifying heat losses and converting temperature differentials into electrical currents, the project sought to optimize energy utilization.

**Stress Detection in Astronauts:** This experiment evaluated the efficacy of multiple sensors in detecting stress levels among astronauts during analog missions, investigating correlations with workload, physiological measurements, and mental fatigue.

Biocontamination in Isolation: This experiment studied the behavior of microorganisms in space habitats, employing staining techniques to identify and characterize microbial species present in different sections of the base and on crew members.

The multidisciplinary approach of the EuroMoonMars program contributes significantly to advancing capabilities for future lunar exploration missions and habitat design.

Key Words: Aquaponics, Piezoelectric, Seebeck effect, Biocontamination