Testing Facilities for Extreme Analogue Simulations: ExoGeoLab, ExoHab, ExoLab

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Introduction

We have developed with ILEWG since 2008 an evolving pilot research programme "EuroMoonMars" with a Robotic Test Bench (ExoGeoLab) [1,2] and a Mobile Laboratory Habitat (ExoHab) at ESTEC . They can be used to validate concepts and external instruments from partner institutes. Field campaigns have been conducted in ESTEC, EAC, at Utah MDRS station , Eifel, Rio Tinto, Iceland, La Reunion, Hawaii, and LunAres base at Pila Poland in summer 2017.

Goals and methods of EuroMoonMars & ESTEC ExoGeoLab, ExoHab, ExoLab

We integrated instruments integrated in an ExoGeoLab test bench, crossing various techniques. The methodic steps for this hands-on research are:

1) We have procured and adapted instruments to equip a small surface ExoGeoLab demo lander. Some instruments can also be used on a small or mid-size Rover. some instruments can be brought for field site campaigns.

2) This terrestrial payload (instruments, sensors, data handling) has been deployed, operated and used as collaborative research pilot facility (ExoGeoLab), first tested and operated at ESTEC , and later transportable

4) We have implemented the possibility of remote control of instruments from an adjacent mobile laboratory, and a remote science desk.

5) The suite of measurements includes a comprehensive set with telescopic imaging reconnaissance and monitoring, geophysical studies, general geology and morphology context,geochemistry (minerals, volatiles, organics), subsurface probe, sample extraction and retrieval, sample spectroscopy analysis.

6) We have reproduced some simulation of diverse soil and rocks conditions (mixture of minerals, organics, ice, penetrations of water, oxydant, organics, living organisms & plants) and diagnostics

7) We used these instrument packages to characterise geological context, soil and rock properties

8) Science investigations include geology, geochemistry, mineral, oxydant, organics, and volatiles diagnostics.

9) After first validations we started to exploit the facility for collaboration with partners that have provided some additional guest instruments, and perform specific investigations,

10) We can make use of the mobile lab habitat ExoHab for logistics support and local operations.

11) An additional ExoBiology Laboratory module (ExoLab) has been equipped to support related technical research. A new version ExoLab 2.0 was developed over summer 2017

12) From this test bench and kit of ExoGeoLab instruments, we plan to operate comprehensive instruments packages that could help in the technical research and science preparation of future lander/rover missions.

This research can benefit the frame of Science, Exploration or Application programmes, or in support of International Tasks Groups such as ILEWG, IMEWG, ISECG, space agencies, and research partners.

Field tests of ExoGeoLab Lander Demonstrator:

We have built a demonstration model for a generic small planetary lander. This ExoGeoLab lander was developed in partnership with ILEWG, ESTEC in synergy with the requirements from the Google Lunar-X Prize GLXP competition. The platform allows to accommodate a flexible suite of instruments for different missions configurations (e.g. GLXP, lunar science, lunar polar exploration, Mars exobiology, Mars

environment, outer Moons). The ExoGeoLab lander was upgraded to allow remote operations of cameras, a fiber -fed spectrometer, a telescope and various lander subsystems. It was tested at ESTEC outdoor field area (Fig. 2).

Fig 1 (left) : we thank ILEWG EuroMoonMars 2017 campaign crew at ESTEC (here with ExoGeoLab lander & Puli Rover) & at simulation campaigns (PMAS, LUNEX1, IcAres) at LunAres base, Poland. Fig. 2 (right), ILEWG ExoGeoLab lander with remotely controlled USB4000 spectrometer and rover

References

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Short Summary

We developed with ILEWG an evolving pilot research programme "EuroMoonMars" with Robotic Test Bench (ExoGeoLab), and a Mobile Laboratory Habitat (ExoHab & ExoLab) at ESTEC . Field campaigns have been conducted in ESTEC, EAC, Utah MDRS station , Eifel, RioTinto, Iceland, La Reunion, and LunAres base at Pila Poland in 2017.