EXOGEOLAB LANDER, ROVERS & INSTRUMENTS: TESTS AT ESTEC & EIFEL VOLCANIC FIELD

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Abstract

We have built an ExoGeoLab lander demonstrator for future planetary missions, equipped with remotely operated instruments. We tested them at ESTEC and at an ILEWG field campaign at Eifel volcanic park in Germany in September 2009.

ExoGeoLab

We have started a small pilot facility with a Robotic Test Bench (ExoGeoLab) [1,2] and a Mobile Lab Habitat (ExoHab). They can be used to validate concepts and external instruments from partner institutes. The ExoGeoLab research incubator project, has started in the frame of a collaboration between ILEWG [3] (International Lunar Exploration working Group http://sci.esa.int/ilewg), ESTEC and partners, supported by a design and control desk in the European Space Incubator (ESI), as well as infrastructure. ExoGeoLab includes a sequence of technology and research pilot project activities:

- Data analysis and interpretation of remote sensing and in-situ data, and merging of multi-scale data sets
- Procurement and integration of geophysical, geochemical and astrobiological breadboard instruments on a surface station and rovers (ExoGeoLab)
- Research operations and exploitation of ExoGeoLab test bench for various conceptual configurations, and support for definition and design of science surface packages (Moon, Mars, NEOs, outer moons)

Goals and methods of ESTEC ExoGeoLab:

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

1) We have procured and adapted instruments to equip a mid-size ExoGeoRover, and a small surface ExoGeoLab demo lander.

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 (see Fig.1) , and later transportable

3) We performed functional tests of these instruments, and operated them in terrestrial conditions to correlate measurements using various techniques.

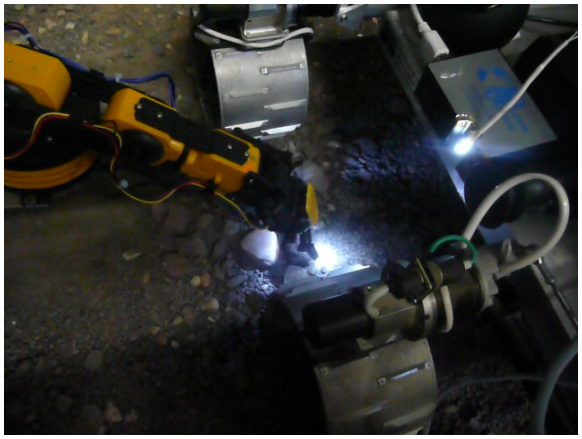

Fig. 1: ExoGeoLab tests of Remote sample Raman and reflectance measurement

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 analysis.

6) We have reproduced some simulation of diverse soil and rocks conditions (mixture of minerals, organics, ice, penetrations of water, oxydant, organics) 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 will provide some additional guest instruments, and perform specific investigations,

10) We plan to organise field campaigns in specific locations of technical, scientific and exploration interest. Field tests have been conducted in ESTEC, at Utah MDRS station [3-6], and at Rio Tinto [7].

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

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 lander/rover missions studied in the frame of Cosmic Vision or the Exploration programme, or in support of International Tasks Groups such as ILEWG, IMEWG, ISECG, space agencies, and research partners.

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 and the AOES company, and 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 tested at ESTEC outdoor field area (Fig. 2).

Fig. 2: ESTEC test of ExoGeoLab lander with remote operations of door and instruments

ILEWG Field campaign at Eifel Volcanic Park

Fig. 3: ExoGeoLab Lander and rover cooperative operations at Eifel volcanic park test site, Germany

We brought the ExoGeoLab lander and suite of instruments for a test campaign at Eifel volcano park in Germany. We tested various phases of a robotic lander mission (rover deployment, lander inspection , instruments remote operations, lander + 2 rovers cooperative operations, sample collection and analysis, see Fig. 3) as well as possible operations during Extravehicular activity astronaut simulations [8].

References

[1] Foing, BH et al . (2009) LPI, 40, 2567; [2] Foing BH and the ExoGeoLab Team, EGU2009-13122; [3] ILEWG http://sci.esa.int/ilewg ; [3] Foing, B.H., Pletser, V., Boche-Sauvan L. et al , Daily reports from MDRS (crew 76 & 77) on http://desert.marssociety.org/mdrs/fs08/.; [4] Boche-Sauvan L., Pletser V. , Foing BH and EurGeoMars Team, EGU2009-13323; [5] S.T.M. Peters, A. Borst, L. Wendt, C. Gross, C. Stoker, J. Zhavaleta, P. Sarrazin, E. Slob, V. Pletser, B. Foing and the ExoGeoLab team & EuroGeoMars Team, EGU2009-13353; Peters S, Borst A, Foing, Stoker et al, LPSC, (2010) LPI, 40 ; [6] C. Thiel, D. Wills, B. Foing, and the ExoGeoLab team, the EuroGeoMars Crew and Support Team, EGU2009-13414; [7] Mahapatra P, Direito S, Foing BH and CAREX Rio Tinto workshop team, (2010) LPI, 41, 1374; [8] Groemer G, Stumptner W, Foing BH, Blom JK and ILEWG Eifel campaign team (2010) LPI, 41