EPSC Abstracts
Vol. 13, EPSC-DPS2019-781-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

VUSE, VU Science Experiments as student project performed at IGLUNA, a human Moon-Ice habitat simulation.

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Abstract,

To explore the possibilities of performing science when building a human habitat on the Moon, a group of students from VU Amsterdam, the Netherlands started VUSE, VU Science Experiments and this group is participating in IGLUNA, organized by the Swiss Space Center and ESA_Lab [1]. This project is a simulation of a human habitat at the South-Pole of the Moon. VUSE is designed and tested to combining glaciology [2], geology, life science experiments [3], astrobiology [4] and analog simulation planning [5] into one science package. During a 16-day campaign the team will perform these experiment, with the goal of providing a showcase of science that could be done within in Moon-Ice habitat and a research to the history of the glacier. VUSE is building on work and experience of previous student groups at the ILEWG Euromoonmars group [6].

1. Introduction

The VUSE team consist of 15 geology and biology students from VU Amsterdam. This independent team is supported by VU Amsterdam and ILEWG. The goals of VUSE is to perform a scientific showcase at IGLUNA campaign in Zermatt. For the scientific showcase we selected four research goals. An glaciology research to discover the history of the ice, using ice crystal deformation analysis [2] and chemical analysis of ice cores. We selected two biology experiments: An study to grow plants efficient with low temperature in an ice cave habitat [3] and an research to search for micro biotical life inside ice using a mini-DNA-sequencer [4]. Outside the habitat we selected a study to use a combination of drones and human analog astronauts for sample picking EVA activities.

2. Science Lab at a Moon-Ice Habitat.

Building a human habitat is an unique opportunity for the science community to collect new data from the moon. Instead of sample return missions, samples can be analyzed in situ by an laboratory inside a habitat. Together with previous work of ILEWG [6], VUSE will contribute to researching the ideal version of a mobile laboratory for Moon habitats. Previous concept laboratories were focused on rock sample analysis under volcanic conditions. With the addition of a ice environment and the collection of ice samples that need to be analyzed during the IGLUNA campaign, the laboratory needs to be adjusted to fulfill the needs to analyze the samples. To analyze ice cores samples, you need a cool storage and cool workspace. Therefore the habitat is being adjusted to temperatures below zero. This mobile lab, build by ILEWG and BTU [7] is installed by instruments from VUSE. For chemical analysis of ice samples, the ice samples need to be heated with precise control. The workspace has been fitted with heaters and tools to prepare ice samples. To determine stress in ice crystals, VUSE will make thin sections of ice and analyse them under a polarized microscope.

3. Scientific systems, and communication between the systems

During the campaign VUSE will have three separate systems working. At and inside the glacier two systems will be the working systems that represent the moon base. At the village of Zermatt a third system is controlling and checking the persons working on the glacier and keeping a direct communication line with remote control at VU Amsterdam. With the use of remote cameras and the control of laptops that are at the glacier, ground control could communicate directly between the glacier and the village. The two systems at the glacier consist of an laboratory module at the habitat inside

the glacier and an autonomous lander, called Exolander. This lander is equipped with telescopes, cameras and drones to observe the area around this lander. For data storage an separate system has been made and every team member will store there data in an open folder

4. Student participation of VUSE

Additional to scientific goals, VUSE is an group that is providing a platform for students to work an astronaut simulations and think about the future of space. We encourage students to participate in workshops, conferences and discussions. Together with ILEWG, VUSE helps organizing workshops for students at ESTEC and organizes students events, like VU Space Day 2018, a symposium with inspiring planetary science experts. The participation to IGLUNA is voluntary, but students who make this their research project get students credit for the project. IGLUNA is an excellent example of how a collaboration of different students can lead to innovative ideas about the future of the space business.

5. Testing

The VUSE project will be tested before the campaign in June 2019. At ESTEC a series of instrumental test has been performed to test the capabilities of the instruments. To prepare for remote control support and EVA planning, the team has been active in the remote support of both the latest HI-SEAS [8] campaign in Hawaii and MDRS-205 in Utah. In 2018 VUSE tested successfully at several locations [9] and prepared their first prototypes.

6. Coordination and logistics of Science simulation missions

The design a science module that includes multiple science researches requires an organized structure of requirements and agreements. The need for an laboratory below zero has complications for other research projects in the project and also in the amount of time that you can work in the lab. In science laboratories concessions have to be made and some experiments will have preference above other experiments. For IGLUNA there are a lot of constraints about the heat release, power needs of the instruments as well as the transport to the glacier at an altitude of almost 4000 meter. VUSE has been modified to perform experiments as efficient as possible within these constraints. For example the plant experiment is going to use limited power and will be isolated to protect the escape of heat. The transport has been solved by making the package as light and small as possible. The altitude of 4000 meter is also been taken into account when designing the experiments

Acknowledgements

We acknowledge the VU Amsterdam Science Experiments (VUSE) IGLUNA team (including B. Albers, M. Daeter, A. Kruijver, D. Beentjes, S. van Bloois, M. Grosjean, I. Brouwer, M. Berg, R. Korthouwer, A. Dingemans, G. Vaessen) We thank coordinators of the IGLUNA project and Swiss Space Centre (including T. Benevides, O. Kirchhoff, G. Petit, E. Buchs and A. Kiener) We thank ESA and ILEWG (prof. B. Foing), Euromex and He Space for supporting the VUSE project.

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