Characterization of Mars and Moon microbial life through terrestrial analogue field research. T. V. M. Clement[1], B. De Winter[2], B. H. Foing[3, 4, 5] M. V. Heemskerk[3] and VU Amsterdam Igluna Team (B. Albers , M. Daeter, A. Kruijver, D. Beentjes, S. van Bloois, I. Brouwer, M. Berg, R. Korthouwer, A. Dingemans , G. Vaessen) [1]VU Amsterdam (tvmclement@hotmail.com), [2]VU Amsterdam (dewinterbram@hotmail.com), [3]VU Amsterdam, [4]ESA ESTEC, [5]ILEWG.

Introduction: IGLUNA is a pilot project aimed at supporting and accelerating the ESA_Lab initiative. Coordinated by the Swiss Space Center, the goal of this mission is to simulate a habitat on the moon, built in the ice craters near the poles and will be tested in a similar environment inside a glacier in Zermatt, Switzerland [1]. One of the teams participating for IGLUNA is the VUSE (VU Science Experiments) team from VU University Amsterdam [2]. Within this project, the mission of the VUSE team is to design a wide variety of geology and astrobiology experiments that are realistic for application for research on the Moon and Mars.

Astrobiology experiments in this project will focus on the characterization of any present microbial life in the sampled environment. This is important because fine-tuning of such experiments allows us to be more confident that detection of extraterrestrial life, if present, is possible in future space exploration missions. Additionally, the characterization of the microbial population in soil from the sampled sites might lead to discovery of new species of extremophilic microbes and will provide valuable information about the local ecosystem.

For these reasons, the VUSE team is designing experiments for microbial analysis of soil and ice samples obtained during several field research campaigns on terrestrial analogues of both Mars and the Moon. Samples will be collected and studied in situ for presence of microbes and characterization of these microbes.

Goals: Through the combined efforts of geology and biology students, the main goal of the astrobiology experiments is to look for markers of life in the obtained soil- and ice samples. If markers for microbial life are found, the second goal is to characterize these microbes. All equipment is particularly chosen to create a compact, portable and easy-to-use laboratory set-up. Therefore, the experiments can be performed by analogue astronauts in situ.

Locations: The main terrestrial analogue campaign of the VUSE team, IGLUNA, is to take place in June 2019 at Zermatt [1]. However, before that, the team will also assist in the Hi-Seas campaign in Hawaii and MDRS-205 in the Utah desert, both of which are terrestrial Mars analogues [3]. In all these campaigns, samples will be collected for a variety of experiments and some microbial analysis experiments will be performed in situ by the analogue astronauts.

Scientific techniques: In order to characterize microbial life in the obtained samples, a combination of different techniques will be used to determine if there is organic matter present, and if so, to characterize the microbes and determine their species. As a first step, the present analogue astronauts will collect samples of soil (and ice in the case of IGLUNA). These samples will be brought back to the astronaut's habitat for further analysis.

Spectroscopy. In the VUSE compact laboratory set-up a portable OceanOptics vis-NIR spectrometer is present. This device can be used to determine the geological composition of a sample, but also to determine the organic content of the soil sample though near IR fluorescence [4]. Therefore this instrument will be used in the first experiment to characterize any present organic matter in the obtained sample.

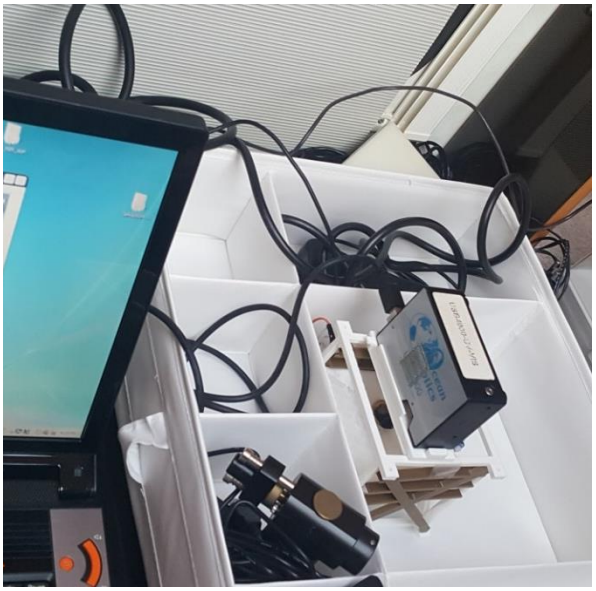

Figure 1. part of laboratory set-up with vis-NIR spectrometer (middle) adapted to a spectralab cube sample holder and other instruments at the ExoHab, ESTEC

Microscopy. A bright-field microscope, and potentially a fluorescence microscope, will be present in the laboratory set-up to allow visual characterization and quantification of microbes in the obtained samples [5]. A variety of stainings will be used to broadly differentiate between different microbial species.

Sequencing. To be able to determine with certainty which microbial species are present in the samples, a portable minION sequencing device will be used. This device is about the size of a USB flash drive and is able to sequence DNA or RNA of samples in real-time and link this to a database, allowing for rapid determination of the present species. It is thus a very good addition to the microbial analysis laboratory for this project.

In addition to the aforementioned equipment, a basic set of necessary life science laboratory equipment, such as Greiner tubes for sample storage, glass microscopy slides, necessary solutions and a set of micropipettes will also be present in the laboratory set-up.

Figure 2. Microscopy setup with polarizing microscope (for geology experiments; left) and bright-field microscope with digital output (right) at the ExoHab, ESTEC.

Equipment tests: Multiple tests will be performed to ensure the functionality of all equipment before the final Igluna experiments take place. These tests will be performed using a functional laboratory module (ExoHab) at the European Space Research and Technology Centre (ESTEC). ExoHab simulates the working conditions of a small terrestrial analogue habitat. Besides the ExoHab, equipment will be tested at other sites. Including those in Hawaii and the Utah desert, before the final project starts at the Zermatt glacier.

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