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EuroMoonMars IMA HI-SEAS 2019: Hydrous alteration of lava flows on Mauna Loa (Hawaii) compared to Martian volcanic soils

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Abstract

Knowledge about planet Mars has experienced an enormous growth over the past decade. With this, Mars has become a central object of interest for geological studies [1]. To learn more about the geological processes on Mars, comparisons with samples from Earth are frequently made. In order to provide more insight in the similarities of the effects of hydrous alteration on volcanic rocks on Mars, samples of different lava flows from Mauna Loa (Hawaii) will be compared by measurements of the Mars Exploration Rovers (MER).

1. Introduction

The sample collection for this research was one of the objectives of EuroMoonMars IMA HI-SEAS mission 1. The main goal of the campaign was simulating a Moon mission for two weeks, from 20 February to 6 March 2019 [2]. The contribution of this research to the EuroMoonMars program includes testing instruments and performing geological research under simulated conditions.

1.1 HI-SEAS

The Hawaii – Space Exploration Analog and Simulation (HI-SEAS) habitat (figure 1) is located at the north-eastern flank of the shield volcano Mauna Loa (Big Island, Hawaii) and has been the home to five successful long duration NASA Mars simulations since 2013. As of 2018, the International Moonbase Alliance (IMA) has been organizing regular simulated missions to the Moon, Mars or other planetary bodies at HI-SEAS. The research and technological experiments conducted at HI-SEAS are going to be used to help build a Moonbase in Hawaii, and ultimately to create an actual Moonbase on the Moon. [3]

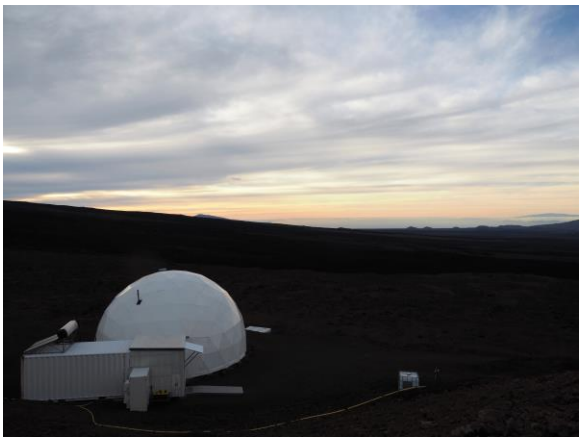

Figure 1: Picture of the HI-SEAS habitat.

2. Fieldwork

The samples were collected from lava flows around the HI-SEAS habitat under simulated conditions, wearing analog space suits during extra vehicular activities (EVA's). To keep the differences in weathering rate by precipitation low, samples in a radius of six kilometers around the HI-SEAS habitat were taken. Only horizontally placed pahoehoe lava flows were sampled, to make sure the top of the lava flow was deposited as observed today. The taken samples were all oriented horizontally, minimizing the possibility of flowing water over the top of the lava flow. Because the rovers on Mars measure the surface of basaltic rocks, only samples from the top 10 cm of the lava flows were taken. Last, to make the weathering processes of the lava flows from Mauna Loa analogous to the weathering processes on Mars,

samples with as less as vegetation as possible were picked.

A total of 23 samples were collected from eight different lava flows with ages varying from 85 to more than 80.000 years old. From these samples, the best thirteen samples were chosen for further analyses. Alteration of the lava flows occurs as a brown layer on top of the flow that becomes thicker as the lava flow is exposed to more precipitation (figure 2).

Figure 2: Picture taken in the field of the alteration layer from a lava flow of 1838 ± 94 years old [4].

3. Further research

Coming months, the samples will be analyzed at VU University Amsterdam. Petrographic microscopy will provide a better insight in the mineral composition. ICP-MS measurements will give the more exact mineral content of the rocks and will deliver a better vision of the elemental content of the minerals. Additionally IR spectrometry will contribute in the understanding of mineral reactions. These data will be compared to spectrometer measurements of the MER Spirit in and around Gusev Crater (Mars).

4. Summary and conclusions

The results of this research will contribute to the understanding of the surface processes on Mars and how the surface of Mars evolved. The research will provide a better understanding of the influence of water on the basaltic rocks on Mars. Also, looking at the age of the lava flows on Hawaii and the rate of alteration and comparing them to Mars deposits, will give information about the time-scale of weathering on Mars.

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