



## **VIS/NIR reflectance and fluorescence spectrometric studies of minerals, water, organics and biomarkers in MoonMars analogue samples**

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This study focuses on the detection and characterisation of elements, minerals, volatiles and organics using reflectance spectrometry. The goal is to create a calibration method to enable the use of spectrometers on analogue Moon/Mars missions and on a lander. For this study we use measurements that are done in the VIS and NIR spectrum, as well as fluorescence using different spectrometers. The first part of the study consists of measurements that are performed in a laboratory to create a calibration method. Different rock samples and soils are analysed and the reflectance and absorption of minerals, water, organics and biomarkers are measured. Also the influence of the grain size, light source and surroundings is being determined. An experiment on the reflectance spectra of plant growth in different soils is also done to determine the possibilities of detecting the presence of chlorophyll and other biomarkers, and to diagnose the growth and health of a plant. This analysis can result in a monitoring method for a Moon greenhouse, but also for general surface analysis. Using VIS and NIR spectrometry has a couple of advantages, one being the fact that measurements require no sample preparation, and also the small size of the spectrometer makes it an easy tool for different analyses on board space missions. However, VIS and NIR spectroscopy have detection limits which makes only certain characteristics detectable. Besides laboratory measurements, the different spectroscopy methods are tested during a field campaign in the Eifel, Germany. During this campaign we can determine the functionality of the spectrometer in the field and on a lander and the problems that can rise when a spectrometer is controlled from a distant or by a person who is not trained in using spectroscopy. These laboratory and field measurements can help in the scientific preparation for instruments on ExoMars rover, future MoonMars lander missions and for the MoonVillage.