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A Blind Test to assess the future ExoMars instruments using samples from the ISAR collection

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Abstract

The future ExoMars mission (2018) has a payload comprising a complementary variety of instruments. We simulated mission procedure by blind-testing these instruments using two unknown terrestrial analogue samples. The data were then evaluated, also "blind", by two geologists. The results demonstrate that the ExoMars instrument suite provides reliable data. It also highlights the importance of using the same analogue samples to test and calibrate the different instruments of an in situ mission. The ISAR collection was thus developed in order to provide analogue samples that can be used for such a payload calibration.

1. Introduction

In situ space missions generally focus investigations on rocks, whether for geological or exobiological research. On Earth, the analysis of rocks may involve numerous instruments depending on the aim of the study. The methods used range from simple optical observations to nanometer elemental analysis using synchrotron radiation. Some of these methods also require more or less complicated sample preparation.

Due to payload limitation in mass and energy and because of the automation of the instruments, several methods commonly used on Earth cannot be utilised during extraterrestrial in situ exploration. These differences necessitate development of new systems that must be tested and calibrated using standards. This instrument calibration phase ideally must be followed by a scientific calibration phase that runs analogue samples through the entire payload of the mission in order to define and improve protocols.

The ExoMars 2018 mission will search for past or extant traces of life in Martian rocks. The instruments of the mission are now well developed and hence we proposed conducting a "Blind Test" of the payload using two unknown but previously well characterised Mars analogue samples.

2. The Blind Test

The Blind Test constituted analysis of two unknown samples using the Raman Laser Spectrometer, MA-MISS, CLUPI and MicrOmega instruments of the ExoMars payload. The different teams in charge of the instruments analysed the two samples consisting of powders and/or small pieces of rock (Fig. 1). The results of the different analyses were then combined and outcrop photography was added, representing the images that will be made by the Panoramic Camera during the ExoMars mission. This dataset was then presented to two geologists having no prior knowledge of the rocks, who then proceeded to construct a geological interpretation. Despite the technical limitations of the instruments compared to laboratory instruments, the geologists were able to make relatively detailed interpretations and were able to identify a chert (microcrystalline quartz with carbonaceous matter) and a komatiite (very primitive volcanic rock). This test demonstrated that (1) the use of the whole payload is necessary to make a good geological interpretation, and (2) all instruments need to be calibrated with the same analogue samples.

3. The International Space Analogue Rockstore

The samples used for the Blind Test were provided by the International Space Analogue Rockstore (ISAR). The ISAR, in Orléans (France), is a collection of well characterized (by optical microscopy, Raman spectroscopy, IR spectroscopy, ICP-MS…) analogue rocks and minerals that can be used to test and calibrate space instruments [1]. The samples were selected for their mineralogical, chemical and/or

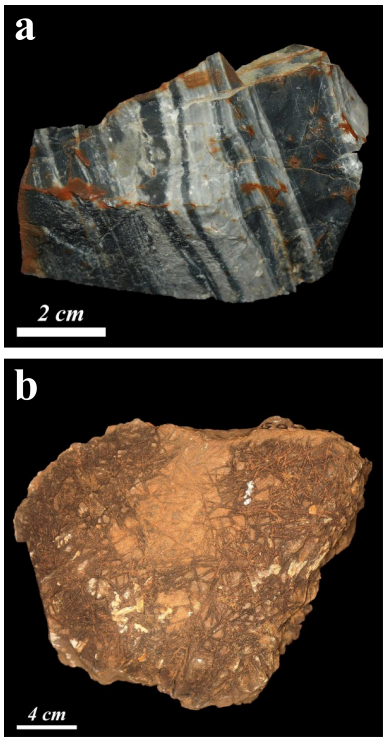

Figure 1: ISAR samples (a) 00AU05 and (b) 10ZA09 used for the Blind Test of the ExoMars instruments.

exobiological features. The collection is associated with an online database accessible via internet at: **www.isar.cnrs-orleans.fr**. It is presently used by several teams in charge of the instruments onboard of the Curiosity rover (MSL, NASA) to improve the in situ interpretations, and by the teams in charge of the ExoMars instruments in order to calibrate and to test their system.

References

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