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A Blind Test to test the future ExoMars instruments

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Abstract

The future ExoMars mission (2018) to determine habitability and to search for traces of past life on Mars has a payload comprising a complementary variety of instruments. We simulated mission procedure by blind-testing the ExoMars instruments using two unknown terrestrial analogue samples. The data were then then evaluated, also "blind", by geologists. The results demonstrate that the ExoMars instrument suite provides good data.

1. Introduction

The future ExoMars mission (ESA/ Roscosmos) will be launched in 2018 to investigate the habitability of the Martian surface and near subsurface materials and to search within for any traces of past or abiotic organics.
In support of this mission a selection of relevant Martian analogue materials were collected and added into the International Space Analogue Rockstore (ISAR), hosted in Orléans, France (**www.isar.cnrs-orleans.fr**) [1]. Two samples from this collection were used to make a Blind Test to test the instruments of the ExoMars mission. The objective of the Blind Test is to determine the level of information provided by the individual instruments, separately and then altogether, and to bring out their complementarity.

2. Materials and Methods

The first ISAR sample chosen for the test (sample A) is a silicified volcanic sediment from the 3.446 Gy-old Kitty's Gap chert, Pilbara craton in Australia (Fig. 1) (ISAR reference 00AU05) [2]. This sample hosts some of the most ancient traces of life in the form of microfossils and organic molecules [3] and is, thus, particularly relevant in terms of the search for life on Mars. The second sample (sample B) is a weathered komatiite from the type locality on the Komatii River in the Barberton Greenstone Belt, South Africa (ISAR reference 10ZA09) (Fig. 2). This sample shows an altered spinifex texture on its weathered surface. Such textures, due to elongated pyroxene or olivine crystals, are specific to komatiites. This sample is particularly relevant because it is Fe and Mg-rich, similar to basic volcanics on Mars in Noachian terrains [4].

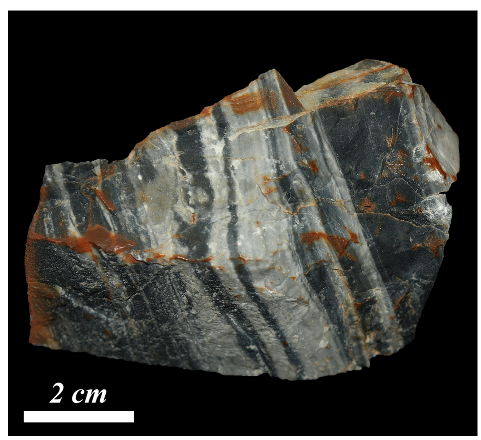

Figure 1: Sample A: silicified volcanic sediment from the 3.446 Gy-old Kitty's Gap chert (ISAR number 00AU05).

Rock slabs or powders were prepared for the Visible, IR and Raman spectrometer (respectively Ma_MISS, MicrOmega, and RLS). Data from each instrument were interpreted by geologists with no knowledge of the nature or provenance of the rocks. Photographs of the outcrops and samples were provided for the expertise.

Figure 2: Sample B: Komatiite from the Komatii river (ISAR number 10ZA09).

3. Results

The first results are really surprising. The geologists rapidly described and interpreted many details of the rocks and discussed their potential interest for the search for traces of life. Thus, they concluded for the sample A that: "The rock is probably a banded chert with anatase and small amount of dioctahedral mica. The whiter beds are siliceous, whereas the darker ones may contain organic compounds. The Raman spectrum eliminated the possibility of a banded marble. Anatase is a heavy detrital phase of either hydrothermal or volcanic origin. Water was involved in the formation of this sediment". For the sample B, they concluded that: "Some arguments (outcrop, macroscopic aspect of a lava, IR spectrum) favour the interpretation of an olivine basalt while other details suggest an ultramafic rock. Firstly, there are primary magmatic features: the spinifex texture of a mineral identified as olivine, with possible magmatic layering, the Mg and Fe^{2+} rich character of the rock. Secondly, there is evidence that this primitive magmatic rock has been altered on the surface under conditions that favour the formation of serpentine, with iron oxidation related features. However, mafic index minerals such as pyroxene and plagioclase were not detected (the white dots visible on the rock surface could be plagioclase). The pargasite identified by Raman is doubtful and complementary XRD data are required to complement or re-interpret the mineralogical diagnostic".

4. Conclusions

We have shown with this exercise that the different instruments of the ExoMars payload will provide important complementary information on the nature (composition, structure, texture) of rocks and other materials, thus leading to good analysis of their composition and history. Note that the data from each instrument needs to be cross-checked with that from the other instruments in order to increase their accuracy and to ensure the reliability of the interpretations. Of critical importance to the geological interpretations of the data were the optical images of the outcrop. However, the lack of quantifiable mineralogical data (X-ray diffraction) did hinder the interpretation process.
Thus we demonstrate that the synergy between the different ExoMars instruments will be the key of success of this future mission.

Acknowledgements

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References

[1] Bost, N. et al.,: Missions to Mars: Characterization of Mars analogue rocks for the International Space Analogue Rockstore (ISAR), Planetary and Space Science, in press, 2013.

[2] de Vries, S.T..: Early Archaean sedimentary basins: depositional environment and hydrothermal systems. Geol. Ultraiectina, Vol. 244, pp. 1-160, 2004.

[3] Westall, F. et al.: Volcaniclastic habitats for early life on Earth and Mars: A case study from 3.5 Ga-old microbial biofilm from the Barberton greenstone belt, South Africa, Planetary and Space Science, Vol. 59, pp. 1093-1106, 2012.

[4] Nna-Mvondo, D., and Martinez-Frias J.: Review komatiites: from Earth's geological settings to planetary ans astrobiological contexts, Earth Moon Planet, Vol. 100, pp. 157-179, 2007.