EPSC Abstracts
Vol. 13, EPSC-DPS2019-408-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Ma_MISS MICRO-SPECTROMTER ON EXOMARS 2020. M.C. De Sanctis (1), F. Altieri (1), E. Ammannito (2), S. De Angelis (1), M. Ferrari (1), A. Frigeri (1), D. Biondi (1), R. Mugnuolo (2), S. Pirrotta (2), T. Di Iorio (3), F. Capaccioni (1), M.T. Capria (1), V. Ciarletti (4), B. Ehlmann (5) , C. Federico (1), G. Magni (1), M. Lavagna (6), M. Formisano (1), S. Fonte (1), M. Giardino (2), G. Piccioni (1), F. Westall (7) and the Leonardo Ma_MISS team. (1) Institute for Space Astrophysics and Planetology, IAPS-INAF, Rome, Italy (mariacristina.desanctis@inaf.it);(2) Italian Space Agency, ASI, Italy; (3) ENEA, Italy;(4)LATMOS, France; (5) Calthec, USA; (6) POLI-MI, Italy,(7) CNRS Orleans, France

The ExoMars 2020 mission will be launched the summer 2020, and ExoMars rover will touchdown at Oxia Planum, a landing site with a strong potential for past habitability and for preserving physical and chemical biosignatures. Ma_MISS is a visible and near infrared (0.4-2.2 μm) micro spectrometer hosted by the drill system of the ExoMars 2020 rover [1]. Ma_MISS is embedeed in the drill tip and the instrument is able to provide hyperspectral images of boreholes excavated by the ExoMars rover drill. Ma_MISS will characterize the mineralogy and stratigraphy of the shallow subsurface [2]. The drill can reach down to 2 m below the surface, and Ma_MISS will operate periodically during pauses in drilling activity and will produce data of the drill's borehole.

The main objectives of Ma_MISS are: (1) determine the composition of the subsurface materials; (2) map the distribution of the subsurface H_2O-bearing and OH-bearing materials and possibly ice; (3) characterize important optical and physical properties of the materials (e.g., grain size); (4) produce a stratigraphic column that will provide information on the subsurface geology.

The Ma_MISS instrument's main driving requirement was its miniaturization because it is embedded within the drill (Fig. 1). The spectrometer is placed in a box on the side wall of the drill box. The spectral range is 0.4–2.2 μm, with a spectral sampling of 20 nm a SNR~100 and a spatial resolution of 120 μm. The borehole is illuminated by a the light of a 5W lamp (Fig.2). The signal is collected and carried, through an optical fiber bundle, to the miniaturized Optical Head, hosted within the drill tip. A Sapphire Window with high hardness and transparency on the drill tip protects the Ma_MISS optical head allowing to observe the borehole wall.

Different depths can be reached by the use of three extension rods, 50 cm long, each containing optical fibers and a collimator. The first extension rod is connected to the nonrotating part of the Drill, hosted on the rover, through a Fiber Optical Rotating Joint, that allows the continuity of the signal link between the rotating part of the drill and the spectrometer.

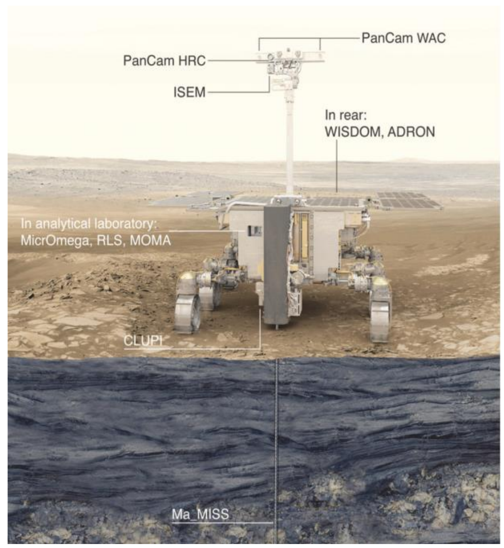

Fig. 1: Artistic view of the ExoMars-Pasteur Rover with instruments allocations. Ma_MISS is integrated within the drill (credits: ESA)

Fig. 2: Ma_MISS light from the zaffire window during tests.

The Ma_MISS instrument has been calibrated and delivered and is now integrated into the drill.

Results obtained in the laboratory on mineral/rock samples during calibration and tests confirm that the

Ma_MISS spectrometer has a spectral range, resolution and imaging capabilities suitable for the Mars subsurface characterization [2,3]. The spectra acquired with the Ma_MISS fine spatial resolution (120 μm) show minerals that are not recognizable at coarser resolution (~6 mm), permitting the detailed analysis of the subsurface composition. An example from test done in laboratory is reported in Figure 3.

Ma_MISS is the only instrument in the rover's Pasteur payload able to analyze subsurface material in its natural condition (*in situ*), prior to extracting samples for further analysis. In synergy with other Rover instruments, MA_MISS findings will help to refine criteria for deciding form where to collect samples. Ma_MISS is a key instrument of the rover mission, being the only one to give detailed information of the mineralogical and geological context of the Martian subsurface.

References:
[1]Vago J.L. et al. (2017): Astrobiology, 17, 6, 7.
[2]De Sanctis et al. (2017): Astrobiology, 17, 6, 7.
[3]De Angelis et al. (2017): PSS, 144, DOI: 10.1016/j.pss.2017.06.005

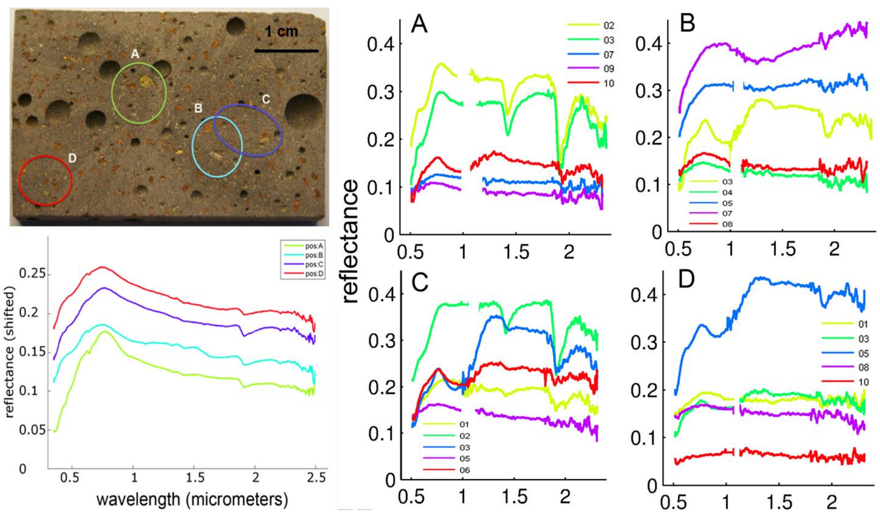

Fig.3 <u>Left Top</u>: slab of Montiferru/Bonarcado Lava. The letters (A,B,C,D) correspond to the areas analyzed with Spectro-goniometer setup. Each area is 6-mm-size; <u>Left bottom</u>: spectra acquired from the regions A,B,C,D, with the spectro-photometer FieldSpec Pro coupled with a mechanical goniometer, having a spatial resolution of about 6 mm. <u>Right</u>: Spectra acquired with Ma_Miss BreadBoard setup. In each single 6-mm-sized area, spectra in different positions have been acquired with Ma_Miss BB setup; Data at 1 μm are not shown in several spectra due to high level of detector noise, as well as data <0.5 μm (figure adapted form [3]).