Testing the ExoMars 2020 scientific exploration protocol

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Abstract

The ExoMars 2020 mission will characterise a Martian locality with potential former habitability – Oxia Planum – and attempt to identify physical and/or chemical biosignatures. In order to maximise the potential for the detection of well-preserved organic molecules, the rover will have the unique ability to drill down to 2 m in depth to collect samples. This method of collecting samples is associated with specific protocols of investigation that we will describe. In particular, we will focus on the geological interpretation of the drill cores collected at 2 m depth. Indeed, in that case, the drill cores may potentially be collected in rocks different from the outcrop observed at the surface. The interpretations must then be made based on the images provided by the Panoramic Camera High Resolution Camera (HRC) and by the CLose UP Imager CLUPI), and completed by analysis carried out in the internal analytical laboratory composed of the Vis-IR spectro-imager MicrOmega, the Raman Laser Spectrometer (RLS), and the mass spectrometer MOMA (Mars Organic Molecule Analyser) after crushing.

In order to train for this specific workflow, a blind test using Mars-analogue lithological samples and mission-equivalent shapes and dimensions (3 x 1 cm cores) was made. We demonstrate that CLUPI and HRC images allow many accurate and detailed geological observations; however, the internal instruments notably provide very important complementary information increasing the confidence and detail of interpretation. Of course the internal instruments are essential for the detection of organics.

Finally, we show that inter-instrumental collaboration will be essential during the ExoMars 2020 rover mission (and indeed in any rover mission), since no single payload instrument is able to perform a comprehensive assessment of a putative biosignature within its geological context, and since the instrument suite provides highly complementary data at multiple scales that are key to maximising scientific return.

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