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CLUPI, a high-performance imaging system on the rover of the ExoMars mission 2020 to discover biofabrics on Mars. Science objectives and development status.

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Abstract

The scientific objectives of the 2020 ExoMars rover mission are to search for traces of past or present life and to characterise the near-sub surface. Both objectives require study of the rock/regolith materials in terms of structure, textures, mineralogy, and elemental and organic composition. The 2020 ExoMars rover payload consists of a suite of complementary instruments designed to reach these objectives.

CLUPI, the high-performance colour close up imager, on board the 2020 ExoMars Rover plays an important role in attaining the mission objectives: it is the equivalent of the hand lens that no geologist is without when undertaking field work. CLUPI is a powerful, highly integrated miniaturized (<900g) low-power robust imaging system, able to sustain very low temperatures (–120°C). CLUPI has a working distance from 11.5cm to infinite providing outstanding pictures with a color detector of 2652x1768x3. At 11.5cm, the spatial resolution is 8 micrometer/pixel in color. The optical-mechanical interface is a smart assembly that can sustain a wide temperature range. The concept benefits from well-proven heritage: Proba, Rosetta, MarsExpress and Smart-1 missions…

In a typical field scenario, the geologist will use his/her eyes to make an overview of an area and the outcrops within it to determine sites of particular interest for more detailed study. In the ExoMars scenario, the PanCam wide angle cameras (WACS) will be used for this task. After having made a preliminary general evaluation, the geologist will approach a particular outcrop for closer observation of structures at the decimetre to subdecimeter scale (PanCam HRC) before finally getting very close up to the surface with a hand lens (CLUPI), and/or taking a hand specimen, for detailed observation of textures and minerals. Using structural, textural and

preliminary compositional analysis, the geologist identifies the materials and makes a decision as to whether they are of sufficient interest to be subsampled for laboratory analysis (using the ExoMars drill and laboratory instruments).

Given the time and energy expense necessary for drilling and analysing samples in the rover laboratory, preliminary screening of the materials to chose those most likely to be of interest is essential. ExoMars will be choosing the samples exactly as a field geologist does – by observation (backed up by years and years of field experience in rock interpretation in the field). Because the main science objective of ExoMars concerns the search for life, whose traces on Mars are likely to be cryptic, close up observation of the rocks and granular regolith will be critical to the decision as whether to drill and sample the nearby underlying materials. Thus, CLUPI is the essential final step in the choice of drill site. But not only are CLUPI's observations of the rock outcrops important, but they also serve other purposes. CLUPI, could observe the placement of the drill head. It will also be able to observe the fines that come out of the drill hole, including any colour stratification linked to lithological changes with depth. Finally, CLUPI will provide detailed observation of the surface of the core drilled materials when they are in the sample drawer at a spatial resolution of about 15 micrometer/pixel in color.

The science objectives and the development status of the close-up imager CLUPI on the 2020 ExoMars Rover will be described together with its capabilities to provide important information significantly contributing to the understanding of the geological environment and could identify outstanding potential biofabrics of past life on Mars.