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ExoMars 2018: the candidate landing sites

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Abstract

The ExoMars 2018 rover and platform will land on Mars with a suite of instruments to search for past and present life. After a call for landing sites in 2013, the selection process is considering 4 potential sites at the moment. The next step should select 2 final candidates during the fall 2015.

1. Introduction

The ExoMars 2018 mission will land a rover on Mars with the scientific objectives to search for signs of past and present life on Mars and to investigate the water/geochemical environment as a function of depth in the shallow subsurface. To this purpose, the rover will carry a comprehensive suite of instruments (the Pasteur payload) dedicated to geology and exobiology research [1]. The rover will be able to travel several kilometres and analyse surface and subsurface samples down to a 2 meter depth. The very powerful combination of mobility with the ability to access in-depth locations, where organic molecules can be well preserved, is unique to this mission [1].

1.1 Landing site constraints

On December 2013, an invitation was sent to the scientific community to propose scientifically compelling landing sites (LS) [2], which comply to the main engineering constraints for landing and operation. These include a landing ellipse of 19 km × 104 km, an altitude < -2 km, a latitude between 5°S and 25°N.
Scientifically interesting LS include locations with evidence for long duration or frequently recurring aqueous activity, low energy transport and deposition, fined-grained, recently exposed sediments, and/or hydrated minerals such as clays or evaporites. The outcrops of interest must be distributed over the landing ellipse to ensure their accessibility. LS must also comply with planetary protection requirements: They must not contain features currently considered as Mars Special Regions [2].

1.2. Eight proposed sites

Initially, eight LS were found to be compliant with the science, engineering, and planetary protection requirements by the Landing Site Selection Working Group (LSSWG) [3]. These sites were presented by their proposers and discussed at the first LS workshop: http://exploration.esa.int/mars/53944-proposed-landing-sites-for-exomars-2018-mission/.

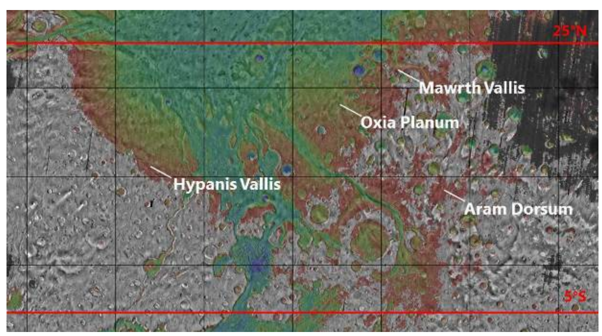

Figure 1: Location of the final candidate landing sites.

2. Landing site selection

Following the first LS workshop, four sites were selected for further investigation (figure 1) on the basis of their higher potential for long lived water activity, the presence of fine-grained sediments, and the higher concentration of potential targets over the whole landing ellipse [3]. The study of these sites, both in terms of scientific interest and engineering safety, is still on-going, and a second workshop took place at the ALTEC facility, in Torino (Italy, December 2014).

2.1. Landing sites overview

We describe hereafter the geology of these four LS as they have been presented at the workshops.

Aram Dorsum (7.9°N, 348.8°E). The proposed ellipse lies in a local topographic low, ~100 km north of Crommelin crater in the large Oxia Palus region [4]. The site comprises layered sedimentary rocks and a distinct inverted channel system. The overlying unit would be late Noachian/early Hesperian, indicating an ancient age for the channel.

Hypanis Valles (11.8°N, 314.96°E). The proposed ellipse is located at the margin of the fluvial fan/deltaic systems at the termination of Hypanis Valles, just below the transition between the highlands and the plains around Chryse [5]. Another deltaic deposit is in Magong crater at the terminus of Sabrina Vallis, just SW of the proposed LS. This LS targets fan-like deposits that were interpreted to be the remnants of a prograding delta. The lower strata of the Hypanis delta appear to be enriched in Fe/Mg-rich phyllosilicates as suggested by CRISM observations, as well as the Sabrina delta.

Mawrth Vallis (22.16°N, 342.05°E). The proposed LS is in middle to late-Noachian terrains south-west of the Mawrth Vallis channel [6,7]. The region surrounding Mawrth Vallis contains one of the largest exposures of phyllosilicates detected on the Martian surface [8], associated to light-toned layered deposits [9-11]. Outcrops at the proposed landing site show a general sequence of Al-phyllosilicates on top of Fe-smectites, indicating a long wet history. The rocks show the highest degree of alteration identified on Mars. The deposition and alteration are ancient (mostly > 3.8 Ga), and the rocks are well preserved.

Oxia Planum (24,55°E ; 18,2°N). The ellipse covers large exposures of Fe/Mg-phyllosilicates rich rocks detected on both OMEGA and CRISM multispectral data [12]. These detections are associated with layered rocks in a topographic low and may represent the south-western extension of the Mawrth Vallis clay-rich deposits, pointing to an extended alteration process. The crust there is ancient (> 4 Ga) and has undergone intense erosion > 3.6 Ga ago, although the phyllosilicate bearing rocks have been exposed only recently (< 100 Ma ago).

2.2. Astrobiological interest

Of interest in all the chosen sites is the evidence for varying amounts of liquid water in contact with volcanic materials, during different time spans. The volcanic substrates could have supported chemolithotrophic life, and even possibly organitrophic life living off the dead lithotrophs [13].

2.3. Further characterisation and down-selection

New data are being actively acquired by the HRSC, HiRISE and CRISM teams to support the ExoMars 2018 landing site selection process. The ellipses are large and new data are important for characterizing the potential science targets and evaluating the safety of the sites. The proposing teams, the ExoMars project team and the LSSWG will continue their analysis and comparison of the sites, aiming to select two final candidate sites by the fall 2015 —in time for the start of the mission's Critical Design Review (CDR). The final selection of the landing site is expected within 2017.

Acknowledgements

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