EPSC Abstracts
Vol. 10, EPSC2015-764-1, 2015
European Planetary Science Congress 2015

The ExoMars 2016 Landing Site

G.G, Ori (1,2), A. Aboudan, (1), A. Pacifici, (1), F. Cannarsa, (1), A. Murana, (1), S. Portigliotti (3), A. Marcer (3), and (4) L. Lorenzoni
(1), Int'l Research School of Planetary Sciences, Università d'Annunzio, Viale Pindaro, 42, 65127 Pescara, Italy (ggori@irsps.unich.it), (2) Ibn Battuta Centre, Universite' Cadi Ayyad, Marrakech, Morocco, (3), Thales Alenia Space – Italia Strada Vecchia di Collegno 243, Torino, (4) ESA, ESTEC, Noordwijk, Holland

Abstract

We present the analysis of the engineering constraints of the ExoMars 2016 landing site in order to assess the EDM landing safety The landing ellipse of ExoMars 2016 is located at Meridiani Planum. The EXM2016 ellipse is 100 km long and 15 km large, with a characterization of 110 km long and 25 km large; it covers a flat area to the west of the Opportunity landing site. The EDL operations require such landing area in line with its ballistic approach. A large number of data sets have been used for this analysis and the final outputs have been a set of maps and the final hazard assessment.

1. Data sets and analysis

The area of the landing site cover a flat area dominated by the Burns formation [1] and possible adjacent lava flows covered by aeolian deposits or a thin veneer of deflated material. The constraints that have been taken into account are the relief and slope at different scales. Relief and slopes at kilometer-scale base lengths can be evaluated using MOLA data down-sampled down to 1 km and 2 km per pixel of resolution using the Steepest Adjacent Neighbor algorithm. Relief and slopes at hectometer-scale base lengths can be evaluated using MOLA data and HRSC DEMs (with resolution down to 75-100 m/pixel, see example of Figure 1). However, the nominal resolution of MOLA data does not allow the direct investigation of the slope at hectometer scales ranging from 100 m to about 460 m. The characterization of the meter/tens of meter slope constraint can only be performed through high-resolution stereogrammetry at the meter length scale (e.g. with HiRISE, MOC, and CTX data). Photoclinometry has been performed on MOC images when stereo data were lacking and, basically, for comparison. In order to verify the slopes constraints at those scales not covered from the available data, it has been assumed that the landing site surface obeys self-affine behaviour. MOLA tracks, HRSC DEMs, HiRISE DEMs and MOC PC2D DEMs have been considered. TES and Themis data have been used to analyse several parameters including thermal inertia, albedo, and bolometric temperature. Impact craters are important morphological features that may create a signicative hazard. More than 190.000 impact craters have been manually mapped filed by morphology (pristine to degraded) and dimensions. The derivation of the rock abundance and spatial distribution can be performed in three ways: IRTM assessment and estimation, and extrapolation from models.

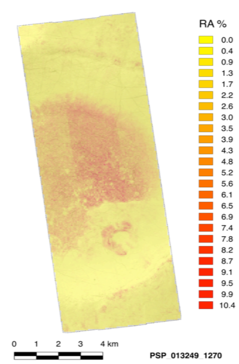

Figure 1: Rock abundance map binned at 64 m. The observed mean rock abundance is 1.7% but locally the area covered by rocks can approach 10% (HiRISE image PSP_013249_1270)

Visual inspection. IRTM has been widely used in the rock property assessment, but estimates are at a spatial resolution of 1 degree bins (60 km). Visual inspection of images is a key method and the automatic identification of rocks on HiRISE images can be extremely useful. To this aim, rock detection software has been developed by IRSPS

2. The landing site

The bedrock of the landing site is represented by the Burns formation, a sequence of similar to the terrestrial sedimentary deposits of desert. This unit consists of aeolian and sebkha-like deposits and it is supposed to underlay the area of the ExoMars landing. Its whitish color is observable all over the landing sites in the fresher crater rims and as small isolated patches. This unit is overlain by a thin (probably no more the a meter) of deflation deposits and megaripple fields. The Northern and Southern tips of the ellipse are dominated by ejecta from relatively large craters located outside the landing area. The area is remarkably flat and high slope values occur where a few large craters occur. Surface properties and geological reconstructions suggest that the area is predominantly composed of a thin layer of regolith made up of pebble size clasts and indurated intervening fines. Large clasts (B axes in excess of 10 cm) are scattered over the surface, mostly in correspondence of crater ejecta.

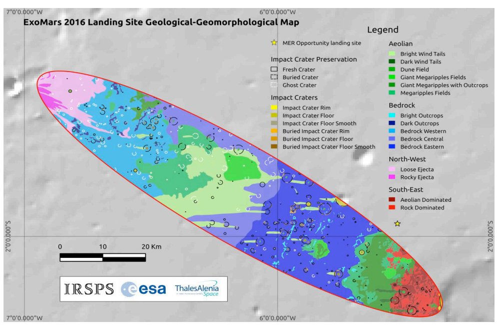

Figure 2: Morpho-geotechnical map of the landing site.

6. Summary and Conclusions

The landing site of ExoMars 2016 shows the typical features of the Meridiani Planum area as depicted by the Opportunity rover. The area has been deeply investigated in term of engineering constraints and geological features. This analysis has put in evidence and confirmed the suggestion that this area is one the safest zone on Mars for landing. Nevertheless, the geological variability and limited knowledge of the whole area at the requested resolution, still requires a probabilistic analysis for EDL operations.

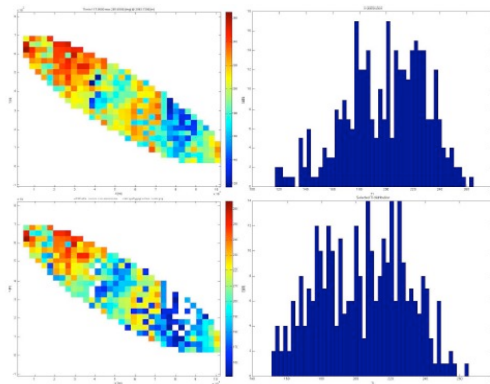

Figure 3: THEMIS-derived thermal inertia and histograms for the studied landing site.

References

[1] Grotzinger J.P. et al..: Stratigraphy and sedimentology of a dry to wet eolian depositional system, Burns formation, Meridiani Planum, Earth and Planetary Sci. Lett., Vol. 240, pp. 11-72, 2005.