EXOMARS 2020 LANDING SITE SELECTION AND CHARACTERISATION. J. C. Bridges[1], A. Parkes Bowen[1], P. Fawdon[2], M. Balme[2], J. Vago[3], E. Hauber[4], D. Loizeau[5], R. M. E. Williams[6], E. Sefton-Nash[3], S. M. R. Turner[1], J. M. Davis[7], P. Grindrod[7], S. Gupta[8] and the ExoMars Landing Site Selection Working Group. [1]Space Research Centre, University of Leicester, UK (j.bridges@le.ac.uk), [2]Open University, UK, [3]ESTEC, Netherlands, [4]DLR, Berlin, Germany, [5]Laboratoire de Géologie de Lyon, [6]Planetary Science Institute, USA, [7]Natural History Museum, UK, [8]Imperial College, London, UK.

Introduction: Following the 4th workshop carried out by the Landing Site Selection Working Group (LSSWG) in 2017, the ExoMars 2020 rover has had its landing site downselected to two candidates; Oxia Planum and Mawrth Vallis (Fig.1), with the Aram Dorsum site being downselected.

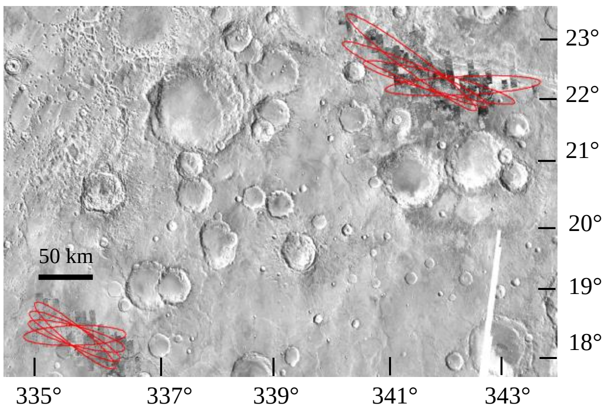

Figure 1. Regional View of ExoMars landing site locations.

Carrying on from this decision, imaging of Oxia Planum and Mawrth Vallis continues apace, with only a few gaps remaining in 25 cm/pixel HiRISE coverage of Oxia Planum, and ~75% of the Mawrth Vallis site covered at the same resolution. Those images already acquired are currently in the process of being checked for defects e.g. image bit flips, intervening clouds/dust etc. The ExoMars LSSWG and site teams have carried out rock abundance, crater counts and Transverse Aeolian Ridge (TAR) [1] characterization principally using HiRISE image data (Table 1). In addition regional geological mapping between Mawrth and Oxia Planum is taking place [2-5] by the wider ExoMars team.

This effort will be augmented by the CaSSIS instrument once the Trace Gas Orbiter has entered its final science orbit in 2018. It will be able to provide complementary colour information to HiRISE over 9.5 km swaths, in different seasons, as well as allowing easier acquisition of stereo imaging within one pass of an image site [6]. Due to the sites being relatively dust-free, and consequently exposing their diverse range of minerals and lithologies, colour imaging of Oxia and Mawrth for terrain characterization may be particularly useful.

Candidate Landing Sites: *Oxia Planum 18.1 ºN, 335.8 ºE:* is thought to be composed of layered, clay-rich deposits formed during the Noachian epoch, overlain by both a Noachian fluvio-deltaic system and an Amazonian capping unit [4, 7-9]. Intense erosion between each of these periods has exposed surfaces as young as ≤100 Myr [9], allowing for the rover to analyse areas from across the geological history of the site. In addition to the known presence of clays, one of the scientific questions for the Oxia Planum site is whether the remnant fan, associated with Coogoon Vallis, at the eastern end of the landing ellipse, is deltaic. If it is, determining when the delta formed would be important in charting the history of aqueous activity, particularly in the eastern side of the site.

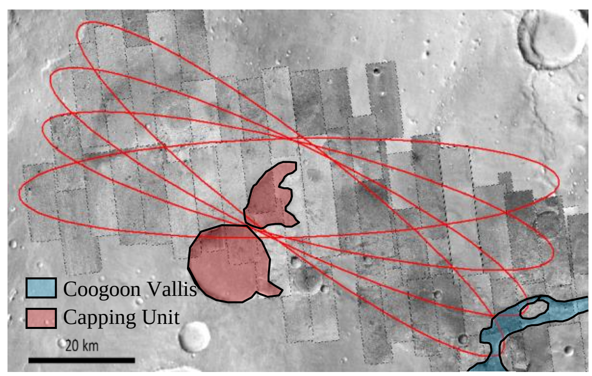

Figure 2. HiRISE coverage of Oxia Planum. The landing ellipses show the range of possible azimuths.

Mawrth Vallis 22.2 ºN, 342.1 ºE: Data from the OMEGA and CRISM instruments have shown that Mawrth hosts a relatively wide variety of altered minerals [10]. Spectral signatures across the region that includes the landing ellipse suggest the presence of abundant Fe/Mg and overlying Al-rich phyllosilicates as well as sulfates [5, 11]. One hypothesis to explain the clay signatures is the presence of reduced paleosols [11-13]. The clays are capped by a regionally-extensive dark mesa-forming capping unit that exhibits unaltered mineral (pyroxene, plagioclase) spectral signatures [5]. From crater counts by the site proposal team, the cap rock is 3.7 Gy old (Early Hesperian) and has played a major role in preservation of the clay-rich deposits [5].

Further Characterisation of the Landing Sites: Prior to downselection to the final site, further HiRISE imaging and assessment of their terrains will take place to assess compliance with engineering constraints and hazards (Table 1) and develop science cases. For instance, the next stage of site characterisation will include assessing the record of water-rock interaction at the two sites. An important way of doing this, in addition to the ongoing work by site proposers, is comparison with HiRISE and *in situ* studies from the MSL mission. The Curiosity rover has directly observed fine-grain sediments, (mudstone), as well as evidence of diagenetic alteration. In Gale Crater, evidence for diagenesis includes the formation of clays, sulphate veins, and silica-rich haloes [14, 15]. In this way different hypotheses for the formation of the clay-rich secondary assemblages at Oxia Planum and Mawrth Vallis can be tested to help inform final site selection. It will also aid in target selection for the rover's eventual traverse.

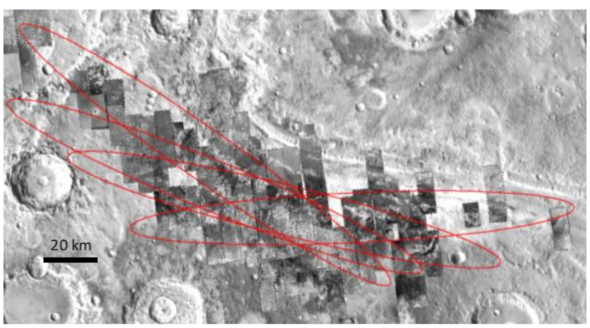

Figure 3. HiRISE coverage of Mawrth Vallis. The landing ellipses show the range of possible azimuths.

References: [1] Balme M. et.al (2008) Geomorphology 101, 4 703-720 [2] Loizeau D. et.al (2015) JGR:P, 120 1820-1846 [3] Fawdon P. et. al. (2017) BPSC, 76 [4] Quantin C. et.al (2017) ExoMars LSSW#4 [5] Poulet F. et.al (2017) ExoMars LSSW#4 [6] Thomas N. et. al (2017) SSR, 212 1897-1944 [7] Quantin C. et al. (2014) ExoMars LSSW#1 [8] Quantin C. et al. (2015) ExoMars LSSW#3 [9] Quantin C. et al. (2015) EPSC 2015, 704 [10] Poulet F. et al. (2014) Icarus 231, 65-76 [11] Noe Dobrea E. Z et. al. (2010), JGR:P, 115 E7 [12] Retallack G. et al. (2000) GSA Sp. Pap. 344 [13] McKeown N. et. al. (2009), JGR:P 114 E2 [14] Frydenvang J. et al (2017) Geophys. Res. Lett., 44 [15] Bridges J. C. et. al (2015) JGR 120 1-19.

Please note that the landing site reports of the LSSWG, referenced by [4] and [5] are available at; https://www.cosmos.esa.int/web/4th-exomars-lss-workshop/supporting-materials

	Oxia Planum	Mawrth Vallis
Latitude, Longitude	18.14 N, 335.76 E	22.16 N, 342.05 E
Azimuth Range	100-125°	102-129°
Semi-Major Axis	60 km	60 km
Elevation	100% <-2 km -3.6 km to -2.66 km	≥ 89% <-2 km -3.02 km to -1.46 km
Slopes	**% Compliant**	**% Compliant**
2-10 km	> 94	>92
330 m	99	99
7 m	95	89
2 m	96	90
Thermal Inertia	100% ≥ 150 $Jm^{-2}s^{-0.5}$ K^{-1}	99.5% ≥ 150 J m^{-2} $s^{-0.5}$ K^{-1}
Albedo	100% 0.1 - 0.26	100% 0.1 - 0.26
TAR Coverage	4.4%	7.2%
Rock Abundance (d≥18, 35 cm)	8%, 5%	7%, 4%
Crater distribution	**No. per km^2**	**No. per km^2**
(high priority targets)	3.73	1.15
(low priority targets)	4.17	2.91