HiRISE SCALE CHARACTERIZATION OF THE OXIA PLANUM LANDING SITE FOR THE EXOMARS ROSALIND FRANKLIN ROVER. E. Sefton-Nash[1], M. Balme[2], C. Quantin-Nataf[3], P. Fawdon[2], M. Volat[3], E. Hauber[4], C. Orgel[1], O. Ruesch[5], A. Frigeri[6], J. L. Vago[1] & the ExoMars RSOWG 'Macro' group. [1]European Space Research and Technology Centre (ESTEC), European Space Agency, Noordwijk, The Netherlands (e.sefton-nash@cosmos.esa.int), [2]The Open University, Walton Hall, Milton Keynes, United Kingdom, [3]Laboratoire de Géologie de Lyon, Université de Lyon, Lyon, France [4]Institut für Planetenforschung, Deutsches Zentrum für Luft und Raumfahrt (DLR), Berlin, Germany, [5]University of Münster, Germany, [6]Istituto di Astrofisica e Planetologia Spaziali (INAF-IAPS), Via del Fosso del Cavaliere, Roma, Italy.

Introduction: Oxia Planum (OP) will be the landing site for the ESA-Roscosmos ExoMars Programme's 2020 mission (*Figure 1*). The descent module and landing platform, *Kazachock,* will transport the *Rosalind Franklin* Rover to OP. With the primary goal of searching for signs of past and present life on Mars, *Rosalind Franklin* ('RF') will investigate the geochemical environment in the shallow subsurface over a 218-sol nominal mission [1].

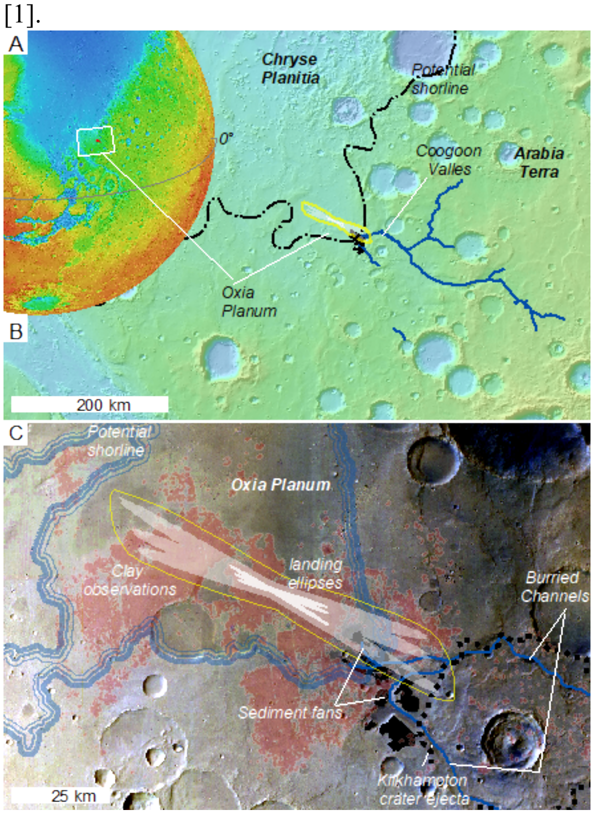

Figure 1: *A) The locations of OP on (A) Mars and (B) in Arabia Terra. C) Key features; landing ellipses, phyllosilicate detections (after* [2]*), -3000 m contour, fluvial channels and sediment fan remnants.*

Oxia Planum: OP is located at the transition between the ancient terrain of Arabia Terra and the low lying basin of Chryse Planitia (Figure 1). OP forms a shallow basin, open to the north, characterized by clay-bearing bedrock, and contains units from ~mid-Noachian to ~early-Amazonian in age [3,4].

There have been at least two distinct phases of aqueous activity within the landing site area. During the mid-Noachian (estimated age is 4.0 Ga), the first one resulted in clay-rich deposits, ~100 m of layered material, that we can observe today. These clay bearing units comprise Mg/Fe smectites overlain by more Al-rich materials. After a substantial hiatus the second phase of aqueous activity included a fluvio-deltaic system. This fluvial activity post-dates the clay-rich layered unit, and is associated with the younger set of channels in Coogoon Vallis, which feeds into the Oxia basin. There is abundant evidence for intense erosion across OP. There are isolated buttes, perhaps remnants of a once-extensive layer that superposed the clay-bearing unit, and a dark, mafic-rich, resistant unit of Amazonian age (<3 Ga) that crops out in association with inverted landforms. Despite this erosion, crater statistics indicate that the clay-bearing rocks are Noachian in age, but have constantly been denuded. This supports the hypothesis that potential shallow subsurface organic biomarkers may have experienced low damage from exposure to cosmic radiation.

High resolution mapping campaign: Gaining a thorough understanding of the OP landing site prior to operations will provide testable hypotheses that facilitate interpretation of results, and hence provide an effective approach to address the mission's science objectives. In pursuit of this, the 'Macro' sub-group, part of the Rover Science Operations Working Group (RSOWG), has been tasked to perform a detailed group mapping exercise of the OP landing site. The work prioritizes the 1-sigma landing ellipses, but incorporates interpretations from elsewhere in the 3-sigma envelope and beyond. Complementary CTX-scale mapping will cover the wider area around the landing site and is described elsewhere [5].

The objectives of the campaign include to:

(1) Provide a detailed geospatial dataset comprising a geologic map, potential science targets, and surface features and hazards at OP. From this, testable hypotheses will be developed, elaborating on

work completed during the landing site selection process.

(2) Familiarize scientists from across the different instrument teams and disciplines represented on RF with the geology and geography of the landing site in anticipation of rover operations.

(3) Reconcile and analyse data gathered during the exercise to compile a morpho-stratigraphic map of the landing site that can feed into rapid reconnaissance mapping (e.g. [6]), preliminary traverse planning, and allow development of hypotheses that are testable as part of the science operations strategy.

Schedule and Organisation: The campaign coordination/leadership team begun planning in Q4 2019 and work is arranged into phases (*Figure 2*).

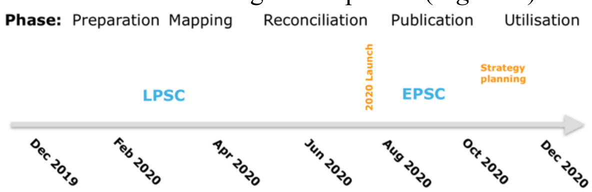

Figure 2: *Mapping campaign timeline and phases.*

Quads. We will use a grid of 1×1 km 'quads' to cover the 3-sigma landing ellipse envelope (*Figure 3*). Of these, 116 quads cover the 1-sigma landing ellipses (whose variation in location and azimuth changes during the launch window): our primary target for mapping. More than 60 individuals associated with RSOWG have volunteered to map and, following training on best mapping practices and contextual geology, will each be allocated quads to map at a fixed scale.

Data and Tools: A group at NASA/JPL have authored an open-sourced the Multi-Mission Geographic Information System (MMGIS) [7]. An enhancement to this tool with additional functionality for geospatial analysis and mapping has been developed for the NASA Mars 2020 Rover mission: 'CAmpaign Mapping and Planning', CAMP. We have deployed an instance of this tool at ESA ESTEC with the data and configuration necessary to facilitate group mapping.

Volunteers will map on a HiRISE ortho image and DTM mosaic. These data are co-registered with a CTX DTM and orthomosaic, which in turn are georeferenced to the HRSC MC11W mosaic [8].

In the *mapping phase,* many users concurrently map geologic contacts and surface features in their assigned quads. Then, in the *reconciliation phase,* a smaller team reconciles the maps produced by volunteers over all quads. They will use all available datasets to produce a morphostratigraphic map suitable for publication and for use in formulating the rover science operations strategy.

Data output from the 'Novelty Or Anomaly Hunter-HiRISE' (NOAH-H), a terrain classification system based on machine learning techniques [9] and trained for Oxia Planum by the Landing Site Selection Working Group (LSSWG), will support the *reconciliation phase*. NOAH-H will perform supplementary surface textual analyses (SSTA) for HiRISE images in the 3-sigma envelope. It is adept at classifying subtle yet pervasive features, such as small aeolian bedforms and fractured bedrock, and will be especially useful for hazard mapping.

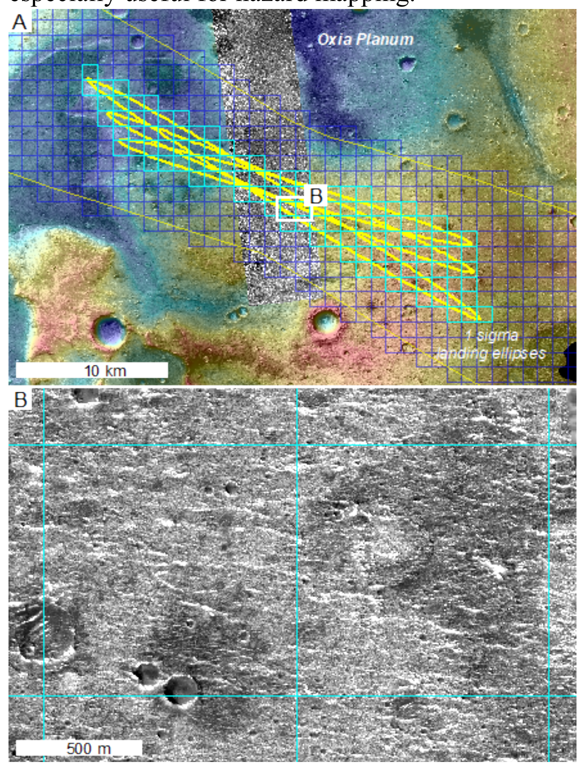

Figure 3: *(A) Distribution of quads covering the 3-sigma envelope (blue) and 1-sigma ellipses (cyan). (B) example terrain: HiRISE ESP_039299_1985.*

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