HYPOTHESES AND IMPLICATIONS FOR THE GEOLOGICAL HISTORY OF OXIA PLANUM. P. Fawdon[1], C. Orgel[2], S. Adeli[4], M. R. Balme[1], J. Carter[4], G. Cremonese[5], J. Davis[6], E. Favaro[1], A. Frigeri[7], P. Grindrod[8], E. Harris[8], E. Hauber[3], L. Le Deit[9], D. Loizeau[10], J. McNeil[1], A. Nass[3], A. Parks-Bowen[11], L. Mandon[12], C. Quantin-Nataf[13], A. L. Roberts[14], N. Thomas[15], D. Tirsch[3], I. Torres[2], S. Turner[16] M. Volat[13], S. de Witte[2], S. D. Woodley[1], E. Sefton-Nash[2], J. L. Vago[2]. [1]The Open University, Milton Keynes UK (peter.fawdon@open.ac.uk), [2]European Space Research and Technology Centre (ESTEC), European Space Agency, The Netherlands, [3]Institut für Planetenforschung, Deutsches Zentrum für Luft und Raumfahrt (DLR), Berlin, Germany, [4]Institut d'Astrophysique Spatiale: Orsay, Île-de-France, France, [5]Istituto Nazionale di Astrofisica Observatorio Astronomico di Padova Vicolo del l'Observatorio 5 35122 Padova Italy, [6]Birkbeck, University of London, London, UK, [7]Istituto di Astrofisica Planetologia Spaziali (INAF-IAPS), Via del Fosso del Cavaliere, Roma, Italy, [8]Natural History Museum, London, UK, [9]Laboratoire de Planétologie et Géosciences, Nantes Université, France, [10]Université Paris Saclay - CNRS - Institute d'Astrophysique Spatiale, 91405 Orsay, France, [11]Department of Physics and Astronomy, University of Leicester, UK, [12]Division of Geological and Planetary Sciences, California Institute of Technology, California, United States of America, [13]Laboratoire de Géologie de Lyon, Université de Lyon, Lyon, France, [14]Department of Earth science and Engineering, Imperial collage London, London UK, [15]Physikalisches Institute, University of Bern, Sidlerstrasse 5, 3012, Bern, Switzerland, [16]Astrobiology OU, School of Environment Earth and Ecosystems, The Open University, UK.

Introduction: Oxia Planum [1] (fig. 1a) preserves a record of the diverse geological process that formed and modified the landscape of western Arabia Terra throughout the geological history of Mars. It is the selected landing site for the reformulated ExoMars Rosalind Franklin mission, the goal of which is to search for evidence of past life whilst characterizing subsurface geochemical environment [2].

The geology of Oxia Planum and encapsulated terrains from the Noachian are dominated by phyllosilicate terrains [3-7] formed during the time of peak habitability potential. The landscape was modified by fluvial activity [8-9] into the early Hesperian to the Amazonian, when any potential habitability was restricted to isolated enclaves. Subsequently, Oxia Planum experienced substantial burial and erosion [4, 8] exposing strata deposited through a large cross-section of time. This cross-section records paleoenvironmental conditions potentially representing a substantial part of martian geological history because Oxia Planum is open to the northern plains of Chryse Planitia and is also connected to southern highlands of Arabia Terra.

Here, we examine relationships between the geological units in Oxia Planum, including those at the proposed landing site for the Rosalind Franklin rover [10], and explore the variety of possible paleoenvironments consistent with constraints from geomorphological observations, compositional interpretations and stratigraphic relationships. We establish a sequence of events, (fig. 2) and a series of 'best working hypotheses' that constitute our best understanding from remote sensing data of the geological history of Oxia Planum.

These results (fig 2) illustrate what the geological exploration of Oxia Planum by the Rosalind Franklin rover can tell us about the geological history of Mars.

Data and Approach: We have drawn on observations of the 6 major groups of geological units established as part of the geological mapping undertaken in preparation for the 2022 mission [8]. These data are combined with observations from newly collected CaSSIS and HiRISE images over 9 study sites (fig 1b). Drawing on all these data and supporting publications [eg; 1-16] we explore the relationships, context and possible interpretations of history of these units across the Oxia Planum region.

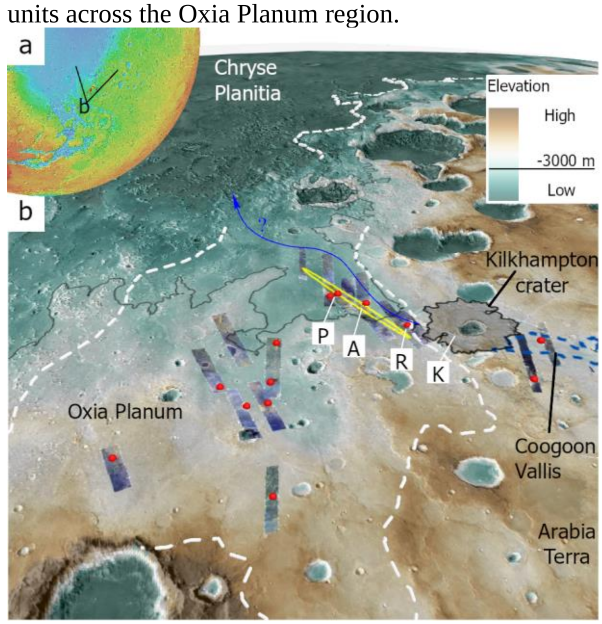

Figure 1: *Oxia Planum on (a) Mars and (b) between Arabia Terra and Chryse Planitia (white boundaries). This shows the proposed landing location (2022 ellipses; yellow), the additional sites used in our study (red), the likely prior extent of Coogoon Vallis (blue), Locations of geographic areas, P, A, R and K [1] illustrated in figure 2 and the CaSSIS data of the sites.*

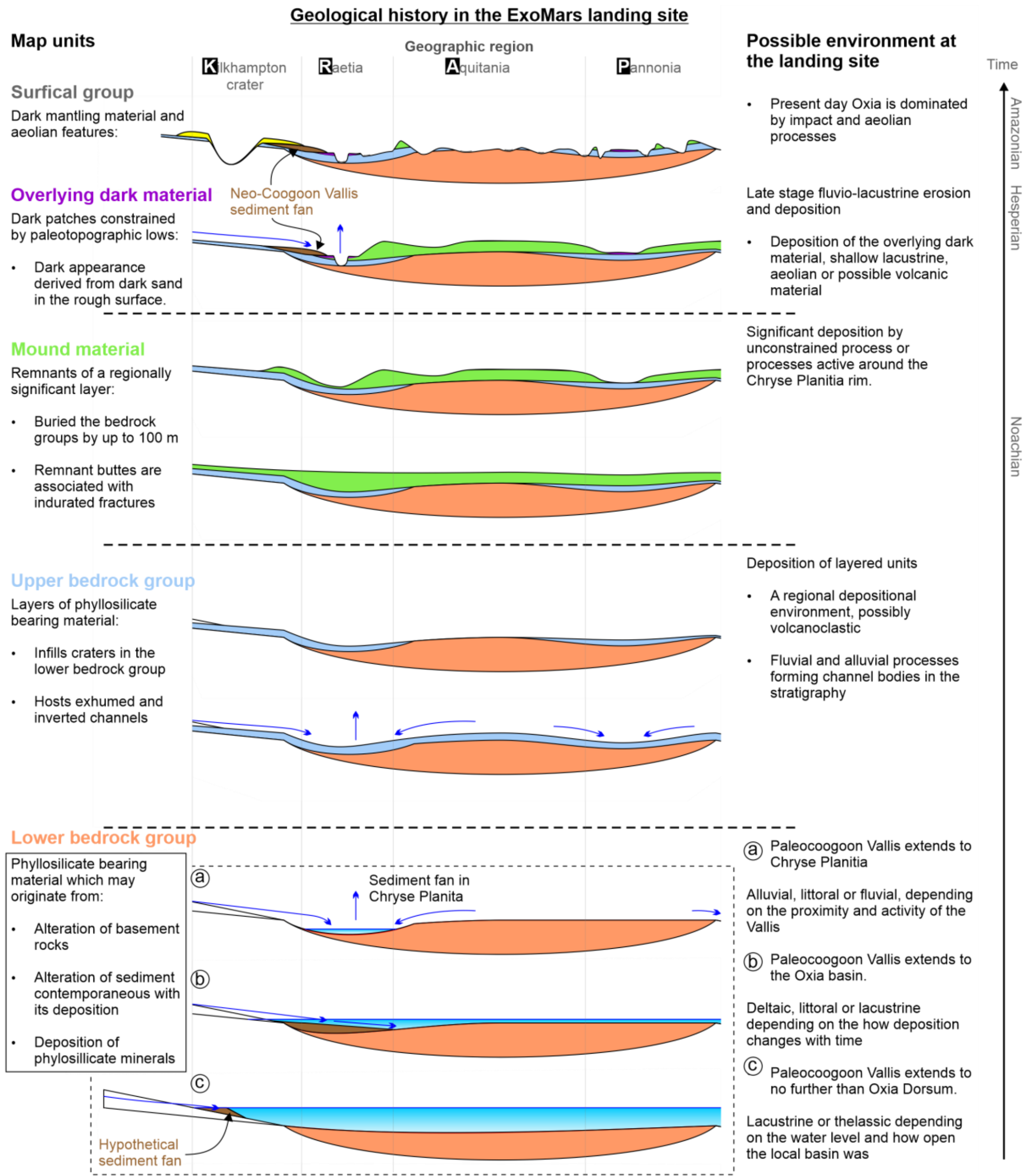

Figure 2: *A summary of best working hypotheses for the geological history of Oxia Planum. Visualized as an E-W schematic cross section of the proposed landing site in North Oxia Planum.*

Acknowledgments: We thank the CaSSIS and HiRISE teams for ongoing data collection. PF thanks UK Space Agency for funding (ST/W002736/1).

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