Characterising the ExoMars 2020 Landing Site

Supervisors:
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Summary:

After several years of landing site selection workshops and ESA Landing Site Selection Working Group (LSSWG) meetings, three possible sites for the ExoMars Rover remain: Aram Dorsum (UK-led), Oxia Planum, and Mawrth Vallis. Down-selection to the 'final and backup' sites will take place in March 2017, and final selection in 2019. The goals of this project are to conduct geological analysis of these sites to develop testable scientific hypotheses, identify key scientific targets of interest in the landing ellipses, and to characterise major hazards to rover mobility. The student will thus play an important role in the ExoMars Rover 2020 landing site selection process.

Description:

The exploration and search for life on Mars is a cornerstone of International Solar System Exploration [*ISECG, 2013; ESA, 2007*]. The Rover's key science objectives [*ExoMars LSSWG, 2015*] are to: 1) search for signs of past and present life on Mars; 2) investigate the water/geochemical environment as a function of depth in the shallow subsurface. To meet these objectives ExoMars will drill into the surface to look for indicators of past life using complementary techniques including assessment of morphology (potential fossil organisms), mineralogy (past environments and water-rock reaction) and organic molecules and other biomarkers.

A unique aspect of ExoMars Rover is its ability to drill to 2 m below the surface to search for well-preserved materials from ancient habitable environments. Thus, choice of site is vital: not only must the site be accessible by the landing system, but it must also be traversable by the Rover and contain suitable targets for sampling (i.e. flat-lying, sedimentary strata, ideally with a well-constrained depositional and modification history). Importantly, ExoMars has smaller wheels and is heavier than NASA Mars Exploration Rovers, so it is likely to be more seriously impeded by hazards formed by aeolian deposits and rocks or small outcrops.

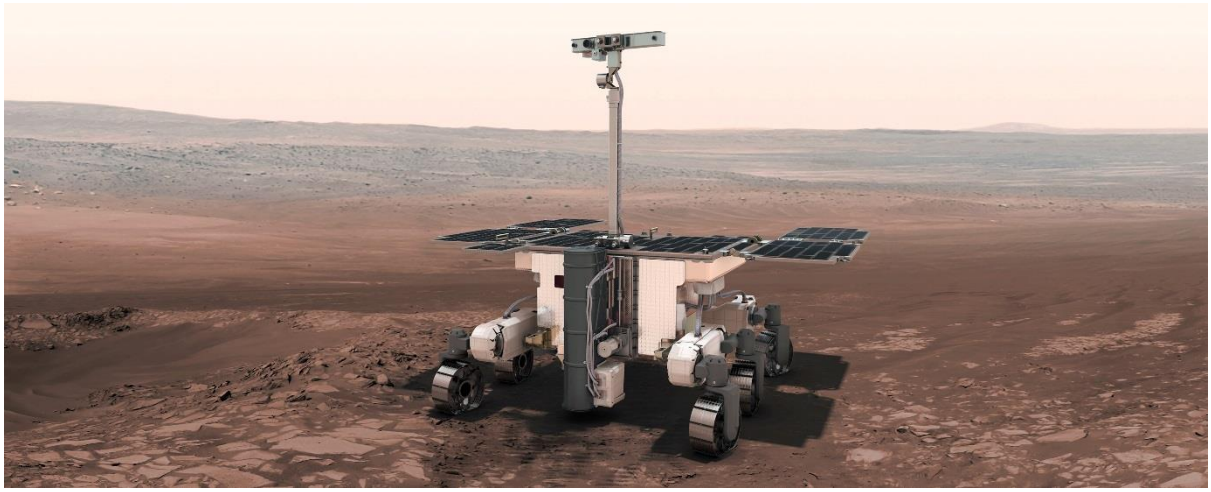

Figure 1. *An artist's impression of the ExoMars 2020 rover on the martian surface. (Credit: ESA).*

Three landing sites have been selected to best meet these constraints. The primary site is Oxia Planum, with the back-up site to be chosen from either Aram Dorsum or Mawrth Vallis, although Oxia Planum could still be ruled out if site validation studies find problems. The final designation of prime and back-up site will be made in late 2017. Following this, both sites will have to be extensively studied to demonstrate that they meet science and engineering constraints, and to prepare for mission operations. All three sites are in Arabia Terra, a transitional zone that occupies the region between Mars' ancient, fluvially-dissected southern-highlands of Sabea Terra and Noachis Terra [*Davis et al., 2016*], and the younger northern lowlands.

The student will carry out geological analyses of the final landing sites. Of particular importance is understanding how each site fits into the regional geology and stratigraphy. This project will use data from a wide range of different instruments, including new data collected from the CaSSIS instrument on board the ExoMars TGO mission, with two of the supervisors recently being appointed Guest Investigators. The student will also help characterise rover hazards due to both aeolian features and steep slopes, in order to assess landing hazards and surface traversability. Thus the student will play in important role in characterising the landing site for the ExoMars 2020 rover.

Research Environment:

The student will be based in the Department of Earth and Planetary Sciences at Birkbeck, University of London, and part of the Centre for Planetary Sciences at UCL/Birkbeck (CPS). The CPS is a cross-disciplinary research group made up from four different departments and over 50 members of academic and research staff. The CPS offers a strong, vibrant and supportive group focusing on cross-disciplinary research themes, and is actively involved in current and future missions. The student will be located in the UCL Regional Planetary Image Facility (RPIF), the only NASA facility of its kind in the UK, which provides remote sensing techniques essential to the project.

References:

Davis, J.M., M.R. Balme, P.M. Grindrod, R.M.E. Williams, S. Gupta (2016), Extensive Noachian fluvial systems in Arabia Terra: implications for early martian climate, *Geology,* 44, 847-850.

ESA (2007), The Global Exploration Strategy, link.

ExoMars Landing Site Selection Working Group (LSSWG) (2015), ESA - Robotic Exploration of Mars: Recommendation for the Narrowing of ExoMars 2018 Landing Sites, link.

ISECG (2013), International Space Exploration Coordination Group, link.