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Characterisation of sites of astrobiology interest for Mars landers and sample return missions

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Introduction: The aim of this work is to nominate and assess candidate landing sites for missions of astrobiological interest to Mars. We report in particular on science and technical criteria and our data analysis for sites suitable for an ExoMars-class mission. This includes information from previous missions (such as Mars Express, MGS, Odyssey, MRO and MER rovers) on mineralogical composition, geomorphology, evidence from past water history from imaging and spectroscopic data, and existence of in-situ prior information from landers and rovers (concerning evidences for volatiles, organics and habitability conditions).

Science Goals and Objectives: Firstly, we look for morphological evidence of hydrological activity, including sedimentary deposits (deltas, valley networks), areas of ancient hydrothermal activity (spring deposits). Secondly, we look for mineralogical evidence of hydrological activity, such as phyllosilicates (formed by alteration due to water, indicate prolonged exposure to standing water), hydrated sulphates (formed by alteration due to water, not necessarily standing water), other water-containing minerals. Thirdly, we prioritise Noachian terrain (during this epoch, $\sim$3.5 billion years ago, the Martian climate may have been warmer, and liquid water may have been stable on the surface). Finally, we look for sites where the potential for preservation of biosignatures is high (exposed bedrock, subsurface regions, spring sinters).

Engineering Constraints: We consider the engineering constraints placed on the ExoMars misson. These include latitude (sufficient insolation for power), landing altitude (sufficient atmosphere for EDL), horizontal winds, shear, and wind turbulence (airbag free fall), radar altimeter reflectivity (for descent and landing control), obstacles and rock distribution (airbag landing), slopes (airbag landing), rover egress, and rover locomotion.

The Priority Sites: Out of a short-list of ten proposed locations, we select two top priority sites and a safe-haven. The sites chosen are Mawrth Vallis (21.6ºN, 344.0ºE) and Vernal Crater (5.9°N, 355.3°E), and a safe-haven in Eastern Meridiani (0° N, 3.7°E). The entire length of Mawrth Vallis is of interest, not least because the source is unknown. It doesn't begin in chaotic terrain like the majority of outflow channels. Weathered phyllosilicates are prevalent and their variety, concentration and surface area are currently unmatched compared to anywhere on Mars. They exist in layered outcrops. Structures in Vernal Crater are strongly suggestive of spring deposits, which would have a high potential for preservation of biosignatures. Other key features of interest at this site include probable lake-shore and regional fluvial deposits, lacustrine layers and evidence of methane activity. Eastern Meridiani has been nominated as a potential safe-haven. The science interest of this site includes many diverse layers, evidence of phyllosilicates, and excavation of underlying material by cratering.

General references: G. Neukum, R. Jaumann et al., HRSC: The High Resolution Stereo Camera of Mars Express, in Mars Express: The scientific payload, edited by A. Wilson, pp. 17-35, ESA, Noordwijk, The Netherlands, 2004; R. Jaumann, G. Neukum, T. Behnke, T.C. Duxburry, K. Eichentopf, S. van Gasselt, B. Giese, K. Gwinner, E. Hauber, H. Hoffmann, A. Hoffmeister, U. Köhler, K.D; Matz, T.B. McCord, V. Mertens, J. Oberst, R. Pischel, D. Reiß, E. Ress, T. Roatsch, P. Saiger, F. Scholten, G. Schwarz, K. Stephan, M. Wählisch, and the HRSC; Co-Investigator Team: The High Resolution Stereo Camera (HRSC) Experiment on Mars Express: Instrument Aspects and Experiment Conduct from Interplanetary; Cruise through Nominal Mission, Planetary and Space Science, 55, 928-952, 2007.