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Geological implications of landing-site candidates of the MELOS mission

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Ancient Mars is now considered to have had environment somewhat similar to that of Earth in terms of the existence of large bodies of water, a wide range of surface oxidation states, appearances of variety of chemical components potentially building blocks of life, and a magnetic field. Endogenic activities have continued even until very recently, and recent water-related geological features indicate prolonged existence of an aquifer system, where a habitable environment may exist for a significant period of time. Occasional releases of volatiles from such an aquifer system may ultimately account for the inconclusive result (not unambiguous denial) of metabolism-detection instrument onboard Viking landers. Japanese MELOS Mars mission is proposed to carry an in-situ life detection package onboard a 150kg-sized rover, as well as a visible-near IR camera and a Ground Penetrating Radar system to perform geological investigation.

Because the primary purpose of the MELOS mission is to perform the Life Detection Microscope (LDM) instrument experiment, which is designed to detect less than 10^4 cells in 1 gram clay, orders of magnitude higher than previous attempts performed by Viking landers, landing-site candidates of the MELOS mission are selected in terms of the possibility of the existence of near-surface water and recent geological and hydrological activities including the possible release of volatiles (specifically, relatively high water activity (Aw>0.6), a relatively higher maximum environmental temperature (T>250), and an existence of gradients of free energy). We propose Melas chasma as a prime candidate because of the existence of recurring slope lineae (RSL), where traces of possible liquid water and seasonal flow have been reported, as well as the fact that Valles Marineris provides the best exposures of the ancient geologic history of Mars. The latter includes: (1) Melas chasma being the widest and deepest part of the Valles Marineris; (2) it being connected to the outflow channels; (3) Interior Layered Deposits (ILDs) showing various sulfates deposits, suggesting the existence of abundant past water; and (4) various phyllosillicates having been detected among the canyon units. As for the current volatile release, we find Tharsis/Elysium Corridor region is the best candidate, which shows evidence of long-lived water enrichment and recent geologic activity, including recent venting that could bring materials from the subsurface to the surface environment. In this talk, we examine the morphologic characteristics of these features and discuss geological context of the candidate landing sites.

Keywords: Mars, MELOS, life detection, water, current activity