NEW LOCATION FOR THE 'NOCTIS LANDING' CANDIDATE HUMAN LANDING SITE ON MARS

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Summary: The 'Noctis Landing' candidate human landing site on Mars, originally proposed at 6.49°S, 92.45°W, is moved 61 km to the SW, to ~7.4°S, ~93.0°W, to allow more ready access to the recently discovered possible buried glacier ice and giant volcano in eastern Noctis Labyrinthus.

Introduction: 'Noctis Landing' is a candidate landing site/exploration zone (LS/EZ) for the human exploration of Mars, originally proposed by Lee et al. (2015) at 6.49° S, 92.45° W at NASA's First Landing Site/Exploration Zone Workshop for Human Missions to the Surface of Mars, convened in October 2015. EZs are 100 km radius areas around a proposed landing site within which human exploration activities would initially focus.

Several considerations and developments are prompting a relocation of the Noctis Landing site: a) establishing a permanent base - accompanied by a versatile mobility capability - is key to enabling long-term scientific exploration and permanent human presence on Mars (Lee 2022, 2004); and given that goal, being able to access H_2O as an in-situ resource is critical; b) a relict glacier that might still harbor ice was recently identified at 7.55°S, 93.25° W, 75 km SW of the original Noctis Landing site (Lee et al. 2023); c) this relict glacier is associated with adjacent terrain interpreted as a vast (~5000 km^2) field of volcanic rootless cones, suggesting a possible large repository of shallow buried ice beyond the relict glacier itself (Lee & Shubham 2024); d) Eastern Noctis Labyrinthus was recently identified as a deeply eroded giant volcano centered at 7.35°S, 94.55°W (Lee & Shubham 2024), increasing significantly the scientific value of the site and warranting relocating the LS/EZ to optimize science opportunities.

Approach: The safety, engineering, and operational criteria used to identify the new 'Noctis Landing' LS/EZ were the same as those used in selecting the original site. Mars Global Surveyor (MGS) Mars Orbiter Laser Altimeter (MOLA) data were used to identify candidate sites > 1 km^2 at elevations < +2 km and with slopes < 5°. Mars Reconnaissance Orbiter (MRO) Context Imager (CTX) and High Resolution Imaging Science Experiment (HiRISE) imaging data, as well as MGS Mars Orbiter Camera (MOC) imaging data and Mars Odyssey Thermal Emission Imaging System (THEMIS) data were used to downselect candidate sites on the basis of terrain smoothness and obstacle clearance. Only sites adequately covered by HiRISE imaging data were considered further. Mars Quickmap, Mars Trek and Google Mars tools were used for data visualization.

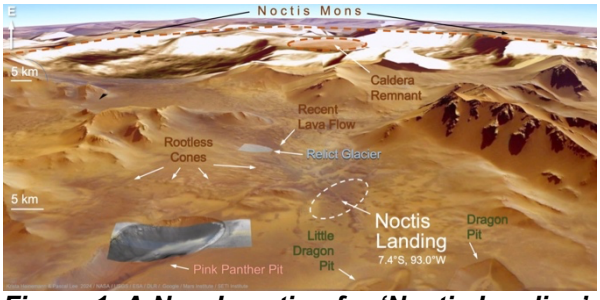

Figure 1. A New Location for 'Noctis Landing'. *The new location proposed for 'Noctis Landing' is within the dashed oval, near 7.4°S, 93.0°W.*

Result: A new location for the 'Noctis Landing' candidate human landing site on Mars is identified near 7.4°S, 93.0°W.

Discussion: The new landing location is a broad, open, subhorizontal (0° to 4° slopes) area ~12 km long and ~4 km wide, with sandy flats ringed by small buttes interpreted as lava flow remnants. The buttes offer options for separation and shielding between a habitat area, a landing/launch pad area, and a nuclear reactor. Although the sandy flats present ripples 1 to 3 times larger than the dunes at 'Rub Al Khali' 2 km south of Endurance Crater where Mars Exploration Rover 'Opportunity' experienced difficulty moving, future human mission mobility systems should be designed to manage even larger dunes on Mars.

Conclusion: 'Noctis Landing' is a candidate human LS near possible near-surface glacier ice.

Future Work: Next steps include planning a possible robotic scouting mission to Noctis Landing and the relict glacier, and to explore other local areas of interest (AOI)s as well.

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References: Lee et al. 2015. *1st LS/EZ Wrkshp Human Missions Surf. Mars*, #50; Lee 2022. *NSS Space Settlement Summit*; Lee 2024. *LSSW-22*, #5012; Lee et al. 2023. *54th LPSC*, #2998; Lee & Shubham 2024. *55th LPSC*, #2745.