

Geology of Lunar Caves and Modern Techniques of Planetary Research

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Lunar caves, including lava tubes and collapse structures associated with impact processes, represent some of the most promising targets in planetary geology. High-resolution orbital observations have revealed hundreds of such features on the lunar surface, providing valuable insights into the Moon's geological evolution and subsurface structure [1].

This seminar paper presents an overview of the lunar geological context, a classification of major cave types, and a general discussion of their formation mechanisms. Particular emphasis is placed on the impact melt pond at the margin of King crater (Al-Tusi melt pond), which serves as a well-studied test site characterized by a diverse range of collapse morphologies [2]. Based on remote sensing data, a conceptual framework for a robotic field mission is outlined, including key operational and logistical criteria for target selection.

Finally, the potential of lunar caves as candidate environments for future human exploration and habitation is discussed. Their natural shielding from radiation, micrometeorite impacts, and extreme temperature variations makes them strategic assets for long-term lunar presence [3;4].

References

- [1] Wagner, R. V. & M. S. Robinson (2014). "Distribution, formation mechanisms, and significance of lunar pits". *Icarus* 237, 52–60, doi:10.1016/j.icarus.2014.04.002.
- [2] Ashley, J. W., M. S. Robinson, B. R. Hawke, C. H. van der Bogert, H. Hiesinger, H. Sato, E. J. Speyerer, A. C. Enns, R. V. Wagner, K. E. Young & K. N. Burns (2012). "Geology of the King crater region: New insights into impact melt dynamics on the Moon". *Journal of Geophysical Research: Planets* 117, E00H29, doi:10.1029/2011JE003990.
- [3] Hörz, F. (1985). "Lava tubes: Potential shelters for habitats". In *Lunar Bases and Space Activities of the 21st Century*, Houston, TX, pp. 405–412. NASA.
- [4] Wynne, J. J., J. E. Mylroie, T. N. Titus, M. J. Malaska, D. L. Buczkowski, P. B. Buhler, P. K. Byrne, G. E. Cushing, A. G. Davies, A. Frumkin, C. Hansen-Koharcheck, V. Hiatt, J. D. Hofgartner, T. Hoogenboom, U. Horodyskyj, K. Hughson, L. Kerber, M. Landis, E. J. Leonard, E. Lesage, A. Lucchetti, M. Massironi, K. L. Mitchell, L. Penasa, C. B. Phillips, R. Pozzobon, J. Radebaugh, F. Sauro, R. V. Wagner & T. R. Watters (2022). "Planetary Caves: A Solar System View of Processes and Products". *Journal of Geophysical Research: Planets* 127 (11), e2022JE007303, doi:10.1029/2022JE007303.