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MAPPING AND MODELLING RECURRING SLOPE LINEAE TO UNDERSTAND THEIR GENESIS

Abstract

Recurring Slope Lineae (RSL) are narrow (0.5–5 m wide) dark streaks that appear seasonally on steep Martian slopes, gradually extending for the duration of warmer months and fading as temperatures drop. Their formation remains a topic of scientific debate, with prevailing hypotheses starting from dry granular flows driven by surface instabilities to temporary liquid water activity facilitated by brine formation. Understanding RSL behavior is critical for interpreting Mars' contemporary surface processes, its climatic records, and the potential for near-surface liquid water. This study focuses on investigating unexplored regions within Valles Marineris (VM) Valley, aiming to discover and examine potential RSL occurrences using high-resolution imagery from the ExoMars trace gas Orbiter (TGO) and Mars Reconnaissance Orbiter (MRO). By mapping spatial distributions, inspecting slope orientations, and monitoring seasonal variations, we aim to decipher whether RSL-like features exist in this region and assess their morphological characteristics. If identified, these streaks can be studied to differentiate among dry and wet formation mechanisms, considering slope-dependent granular flow behavior versus briny water-driven processes. To test the feasibility of dry regolith movement, granular flow simulations will be conducted, modeling how surface materials may shift under Martian gravity and environmental conditions. If evidence supports briny water activity, it would have implications for Mars' hydrological cycle, the potential for microbial habitability, and future in-situ resource utilization techniques. By focusing on the unexplored regions of VM Valley, this research can contribute to the broader understanding of active surface processes on Mars. It builds upon existing research while exploring new terrain, refining our knowledge of RSL distribution, and examining current paradigms regarding their origins. A deeper understanding of RSL formation mechanisms will not only be a useful resource in deciphering past and present Martian climate conditions but also inform the future exploration missions searching for signs of extant water activity.