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Martian Sedimentary Basins and Central Mound Formation

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Abstract:
Central mounds on Mars are observed as sedimentary deposits within crater interiors, but the specific processes responsible for their formation and subsequent modification are still debated. The deposits are hypothesized to have been created by either subaerial or subaqueous processes through one of two general formation mechanisms. The prevailing hypothesis suggests that after their craters were formed, sediment filled the entire crater and was later eroded into the morphologies we observe today. Alternatively, the sediment could have been deposited as the features we observe today without any significant erosion contributing to their mound shape.
We conducted a survey of central mounds that occur within craters larger than 25 km in diameter located between ± 60° latitude on Mars. We use mound locations, mound offsets within their host craters, and mound heights to address various mound formation hypotheses. The results of this survey support the hypothesis that mound sediment once filled the entire host crater and was later eroded into the features we observe today. We propose that large Martian impact craters act as simplistic sedimentary basins. These basins “catch” any sediment that is being transported through the region. Any geologic process that involves transport of material (airfall dust, explosive volcanism, impact ejecta, etc.) could have contributed to the growth of this sediment fill, although the dominant process could vary based on location. During this depositional phase, several processes (ice/frost, water, etc.) could have cemented the material; then, at some point, the environment changed from depositional to erosional, leading to the formation of isolated mounds of sediment within these craters. Our study reveals that most mounds are offset from the center of their host crater in the same direction as the regional winds. For example, the mounds in Arabia Terra are offset towards the western portion of their craters. This observation is consistent with wind erosion being the dominant method of erosion of sedimentary basin fill to form crater central mounds.

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