

Latitudinal and Longitudinal Asymmetries Caused by Space Weathering and Impact Gardening

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Space weathering is interactive processes of planetary surface and solar wind particles, micrometeorite bombardments, and cosmic rays. The lunar craters are good tools for analyzing asymmetries of space weathering caused by solar wind or micrometeorites. The wall quadrants of a lunar crater provide the advantages of being exposed to space weathering for the same amount of time since the crater was formed and being affected by different fluxes by slope of a crater wall. In the present work, we used about 30,000 craters covering latitudes within $\pm 60^\circ$ and the entire longitudes to measure latitudinal and longitudinal trends of flux variation. Through detailed analysis using a large number of craters, we discovered a latitudinal asymmetry and a distinct longitudinal offset between the northern and southern hemispheres. These results trace an evidence of impact gardening caused by meteoroids (probably several tens of meters in diameter) and suggest that meteoroids enter the Moon in an anisotropic or asymmetric way with preferences in direction, possibly along a certain line that intercepts a latitude in the northern hemisphere on average. We expect that these results help quantify the extent to which lunar regolith is mature by solar wind particles and is fresh by meteoroid impacts.