Geophysical Research Abstracts
Vol. 15, EGU2013-5579, 2013
EGU General Assembly 2013

Earth-based radar and LRO Diviner constraints on the recent rate of lunar ejecta processing

Rebecca R. Ghent (1,2), Paul O. Hayne (3), Joshua L. Bandfield (4), Bruce A. Campbell (5), Lynn M. Carter (6), and Carlton Allen (7)

(1) University of Toronto, Department of Earth Science, Toronto, Canada (ghentr@es.utoronto.ca), (2) Planetary Science Institute, Tucson, AZ (rghent@psi.edu), (3) Jet Propulsion Laboratory, (4) University of Washington, (5) Smithsonian Institution, (6) NASA Goddard Space Flight Center, (7) NASA Johnson Space Center

Many large craters on the lunar nearside show radar circular polarization ratio (CPR) signatures consistent with the presence of blocky ejecta blankets, to distances of 0.5 to 1.5 crater radii. However, most of these surfaces show very low surface rock concentration values and only limited enhancements in regolith temperatures calculated from Diviner nighttime infrared observations. Because the radar signal is integrated over the radar penetration depth (up to several meters), but the Diviner signal is sensitive only to rocks within the upper meter of the surface, this indicates that ejecta blocks on the surface and in the shallow subsurface are quickly removed by continued bombardment. Deeper subsurface rocks, which are clearly evident in radar CPR maps but are covered by a sufficiently thick layer of thermally insulating regolith material to render them invisible to Diviner, persist for much longer. By matching the results of one-dimensional thermal models to Diviner nighttime temperatures, we can constrain the thermophysical properties of the upper 1 meter of regolith. We find that Diviner nighttime cooling curves are best fit by a density profile that varies exponentially with depth, consistent with a mixture of rocks and regolith fines, with increasing rock content with depth. Using this density profile together with the surface rock abundance, we can estimate the excess rock mass represented by rocks on the surface and within the upper meter of regolith for individual craters. We find that for craters of known age younger than $\sim$1.7Ga, a robust correlation exists between ejecta mass and crater age, which yields the first observational estimate of the rate of lunar ejecta processing. Our results show that crater ejecta are initially removed very quickly (perhaps up to $\sim$1cm / m.y.), with the rate slowing over a short period of time to less than 1 mm / m.y., as the number of blocks on the surface decreases and the volume of protective regolith material increases, shielding subsurface rocks from the effects of bombardment. In principle, this relationship could be used to constrain the ages of other young lunar craters for which age dating by other means (e.g., counting craters on the continuous ejecta) is not possible. This is important because it has the potential to constrain the recent impactor flux, which in turn bears on our understanding of the evolution of the asteroid belt.