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Vesta and low gravity impact mixing

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Re-impacting material in the velocity range of a few meters per second to a couple of hundred meters per second encounters the surface of Vesta. Studying Vesta's ejecta blankets, this specific constraint has to be taken into account. As on other planetary bodies, young craters are characterized by ray patterns. Combining this information with the evidence of Vesta's unique compaction patterns, the kinematics of the deposition process and its consequences for the spectral properties can be studied. We attempt to tackle the following questions: From which depth of a primary crater and to which extent does ejected material contribute to the mixing of surface material? What are the consequences for the local morphology and a global layer of regolith?
Experiments of slow impacts into granular material resulted in the following significant effects:
1) Different depth to diameter ratios, and different profiles of the impact crater have been found, indicating transition from three dimensional interaction to surface effects.
2) The inner surfaces as well as their ejecta blanket showed quite different mixtures of material from different depths of the target area. These are interpreted as the result of pattern formation, slope and boundary effects.
3) At sufficiently low velocity and suitable projectile density the transition from inelastic to elastic interaction has been observed.
4) Between the elastic response of very slow impacts and a violent irregular agitation of the material by faster impacts, a regime of de-voiding and hence of compaction has been observed.
5) The action of force chains (Daniels et al. 2004, Rivas et al. 2011) became apparent inside the granular material, which efficiently trap energy (Daraio et al. 2006) and lead to the ray system.

These results confirm and expand previous experimental, simulated and theoretically investigated evidence on the behavior of mobilized granular material. As already demonstrated by Cook and Mortensen (1967), low velocity impacts into granular material lead to anything but a simple crater morphology. Unusual scaling laws (Uehara et al. 2003) and much more diverse phase patterns than in ordinary solid media have to be taken into account, if a consistent interpretation of the formation of a crater in very deep regolith is attempted (e.g. Opsomer et al. 2011). Additional effects are due to the low gravity environment on a small planetary body like Vesta (Tancredi et al. 2012). On Vesta many apparent counterparts to the results of the experiments can be found, as demonstrated by some examples. On a global scale, the multitude of small, unresolved primary and secondary impacts into the granular regolith contributes to the observed maturity on Vesta even after short time scales.
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