Mega-scale lunar impact basins: Investigating Procellarum-sized events

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Abstract. The 3200 km diameter Procellarum region is an enigmatic feature of the lunar nearside, noted for its unusually high heat flow and concentration of KREEP elements. Early work[1,2] proposed the region was the site of a mega-scale impact event based on element concentration, thinned crust, and topographic ring-like features. Newer analyses using GRAIL gravity data[3] strongly disagree with these earlier suggestions, proposing a tectonic-magmatic origin, though an impact origin cannot be completely ruled out. The infant Moon would have been subjected to a number of large projectile (>200 km diameter) impact events; Procellarum-sized regions could have formed via impacts. This work, therefore, investigates the formation and outcomes of Procellarum-sized impact basins on the Moon using the iSALE shock physics numerical modeling code[4]. Using a setup comparable to that used to model the 2400 km diameter South Pole-Aitken basin[5], impacts of projectiles >200 km in diameter traveling at 10 and 15 km/s are investigated. Preliminary models demonstrate complete excavation of crustal material for hundreds of kilometers around the impact site, creating a large surficial expanse of mantle material. Melt volumes are in excess >10 million cubic kilometers. The impacts greatly affect the antipodal hemisphere; relatively high strain damages and fractures both the mantle and crust. It is clear, therefore, that the consequences of these impacts are global in extent and would have been likely to affect the formation and structure of younger basins.

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