Compositional Constraints on South Pole – Aitken Basin Formation

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Abstract. The South Pole – Aitken Basin (SPA) is one of the largest impact basins in the solar system[1]. As such, SPA is central to understanding large impact processes as well as a wide range of lunar properties including the composition and structure of the crust and upper mantle.

Basin-scale impacts cannot be recreated experimentally and therefore are studied using a combination of scaled laboratory experiments, computational models, and observations. Basin formation is a dynamic process which vaporizes, melts, displaces, and excavates target materials[2]. For stratified targets such as the Moon, models of basin formation make specific predictions about the post-impact distribution of existing materials as well as any new materials created in the basin-forming event, such as impact melt. The models considered here include vertical impact[3], oblique impact[4], low-speed / large projectile impacts[5], clast-rich impact melt[6], and melt sheet differentiation[7,8].

In this analysis, we compare the predictions made by various impact models to compositional observations to constrain the SPA-forming impact. The primary compositional assessments in this analysis are performed using Moon Mineralogy Mapper[9] (M^3) data. M^3 was a near-infrared imaging spectrometer with high spatial and spectral resolution. In the near-infrared, common lunar minerals exhibit diagnostic absorption bands[10]. Spectral parameters targeting the diagnostic properties of these absorption bands have been developed to perform first-order mapping of composition across the lunar surface. Subsequent impact cratering excavates and uplifts material from depth, allowing characterization of the vertical and lateral spatial distribution of materials in SPA. By comparing these observations to predictions made by impact models, we seek to develop a comprehensive model of SPA formation and evolution, incorporating existing models and proposing additional processes where required. The possibility of mantle exposure and ramifications of this result are also considered.

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[1] D. Stuart-Alexander, *USGS Map* 1-1047, 1978.
[2] H. J. Melosh, *Impact Cratering: A Geologic Process,* Oxford Univ. Press, NY, 1989.
[3] R. W. K. Potter et al., *Icarus,* 220, 2012.
[4] E. Pierazzo and H. J. Melosh, *Icarus,* 145, 2000.
[5] E. Pierazzo et al., *Icarus,* 127, 1997.
[6] S. Stewart, *LPSC XLIV*, #1633, 2011.
[7] D. A. Morrison et al., *LPSC XXIX,* #1657, 1998.
[8] W. M. Vaughan and J. W. Head, *LPSC XLIV,* #2012, 2013.
[9] C. M. Pieters et al., *Current Sci.,* 96, 2009.
[10] R. G. Burns, *Mineralogical Application of Crystal Field Theory,* Cambridge University Press, 1993.