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Extensive Volcanic Resurfacing within the South Pole – Aitken Basin

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1. Introduction

The South Pole - Aitken Basin (SPA) is a vast, ancient impact structure on the lunar farside. Understanding SPA is central to several critical lunar science questions relevant to (1)basin chronology, (2)lower crust/upper mantle stratigraphy and composition, (3)large impact processes, (4)lunar formation/thermal evolution, and (5)lunar volcanism. Recently, we used Moon Mineralogy Mapper (M3) data to evaluate the compositional structure of the basin, identifying four distinct compositional zones [1]. The center-most zone, the SPA Compositional Anomaly (SPACA), exhibits several lines of evidence for extensive volcanic resurfacing.

2. Volcanic Resurfacing Across SPACA

Moriarty and Pieters [1] note several lines of evidence for volcanic resurfacing, across the SPACA region. From local stratigraphy at impact craters within SPACA, the zone was inferred to have a several km thick layer of Ca,Fe-bearing pyroxenes overlying a Mg-pyroxene-rich unit. The SPACA region also exhibits a relatively smooth morphology, with a low density of impact craters. A large proportion of the craters present show signs of significant modification through embayment, burial, or flooding. These pieces of evidence point to extensive resurfacing. But what is the nature of this resurfacing deposit? Do these materials represent an unusual extrusive magma composition? Well-mixed ejecta from nearby basins? A long-lived, differentiated impact melt sheet? Extensive, well-mixed cryptomare? The relationship of SPACA surface materials to the enigmatic structure known as Mafic Mound [2], may provide clues. Mafic Mound is a ~70 km local topographic high within SPACA that has been interpreted to be a volcanic construct based on its morphology and unusual mineralogy. Since the composition of SPACA surface materials are similar to Mafic Mound, this implies a similar formation mechanism. This strongly suggests a volcanic origin for the extensive resurfacing observed within SPACA Understanding SPACA is key for unraveling the complex geologic, geophysical, and thermal evolution of South Pole - Aitken.

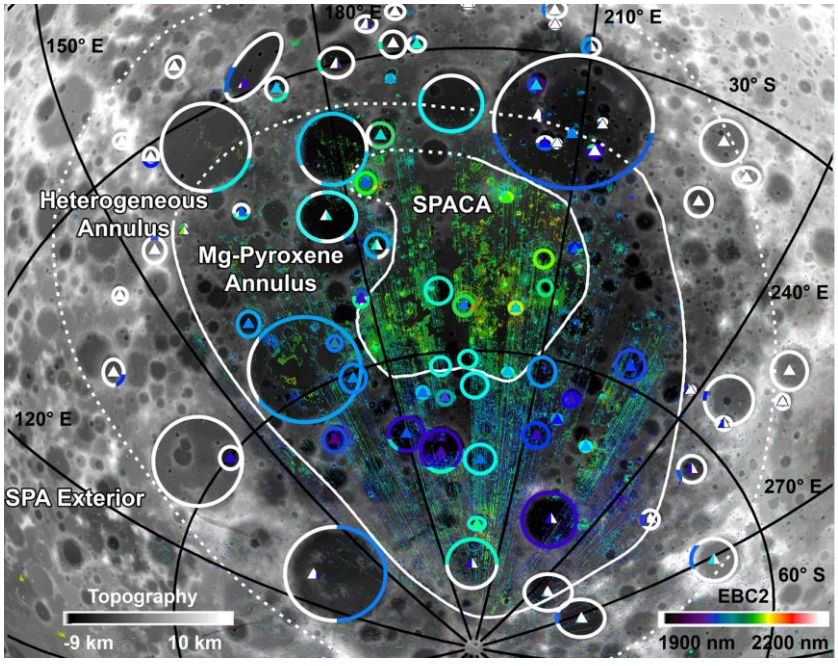

Figure 1: The four distinct compositional zones of SPA as defined in [1]. Basemap is LOLA topography. Colorized pixels correspond to the band center of the 2 micron absorption band derived from M3 data. These band centers are sensitive to pyroxene composition. In general, short wavelength bands correspond to Mg-rich pyroxenes, while longer

wavelength bands correspond to more Ca,Fe-rich pyroxenes. Superposed symbols represent the dominant pyroxene compositions of a suite of large impact structures studied, based on absorption band center. White symbols indicate feldspathic compositions. Known mare basalts have been masked from the M3 pixels to emphasize the diversity in SPA basin materials.

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References

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[2] Moriarty, D. P., & Pieters, C. M. (2015). The nature and origin of Mafic Mound in the South Pole‐Aitken Basin. Geophysical Research Letters, 42(19), 7907-7915.