

Introduction: The ~2300 km South Pole – Aitken Basin (SPA) is the largest and oldest confirmed impact basin on the Moon. As such, SPA formation triggered sustained and far-reaching implications for the thermal and geophysical evolution of the Moon. In the previous two decadal surveys, the National Research Council has defined SPA as a high-priority target relevant to several crucial planetary science questions, including (1) basin chronology, (2) large impact processes, (3) lunar crust/mantle stratigraphy, (4) lunar thermal evolution/volcanism, and (5) the nearside-farside dichotomy.

Until recently, it was thought that the SPA interior was dominated by noritic materials exhibiting Mg-rich pyroxene compositions, with some additional contribution from localized mare basalts with more calcium- and iron-rich pyroxene compositions. However, modern spectroscopic data from Kaguya and Moon Mineralogy Mapper (M^3) reveal an extensive (diameter ~700 km), thick (~5 km) unit in central SPA that exhibits distinctive pyroxene compositions that are intermediate in calcium and/or iron. This SPA Compositional Anomaly (SPACA) is associated with low-lying, smooth topography, a paucity of impact craters, a significant fraction of modified impact craters (via embayment / burial / flooding), and a unique volcanic construct known as “Mafic Mound”. These observations strongly suggest extensive resurfacing as the origin of the SPA Compositional Anomaly.

We have identified four candidate origin scenarios, which we are currently investigating:

1. A differentiated impact melt sheet.
2. Physical mixing of Mg-pyroxene-bearing SPA materials, mare basalts, and subsequent basin ejecta.
3. Cryptomare.

4. Unusual magmatic resurfacing related to the unique geophysical environment of SPA (such as pressure-release melting or localized adiabatic melting resulting from isostatically-induced convection).

Given our current observations, we currently favor scenario 4. However, several of these models may have played a concurrent role in the formation of SPACA, given the complex geological history of SPA.

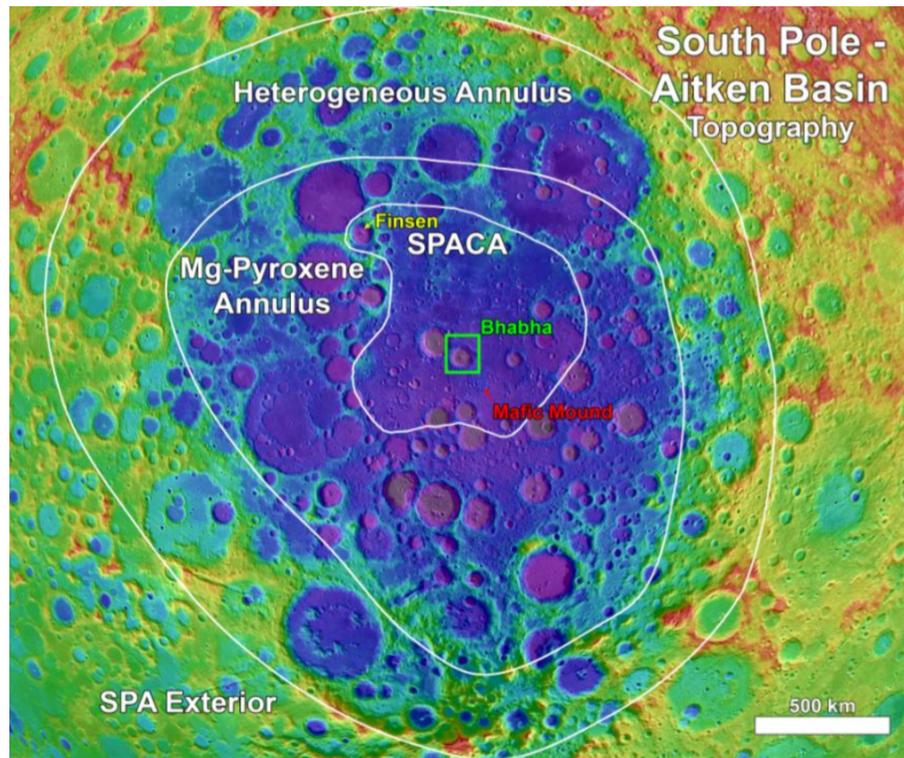


Fig. 1: The four compositional zones of SPA as revealed by M^3 data, overlaid on LOLA topography.