

Mantle Materials and Mysterious Magmas within the Moon's Largest Impact Basin

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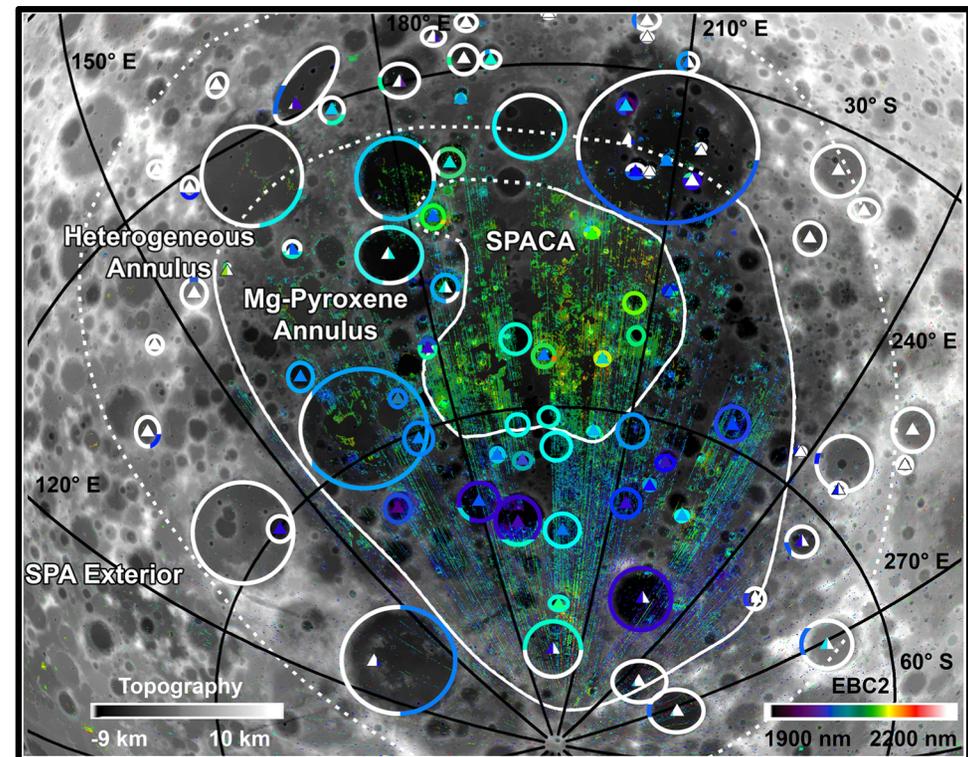
What is the science question? We sought to better understand the landscape and evolution of the Moon's ~2500 km diameter South Pole–Aitken (SPA) Basin by characterizing and mapping its compositional diversity.

What were your findings? Data from the Moon Mineralogy Mapper mission show that the SPA impact basin has four distinct compositional zones clearly demarcated by differences in the abundance and composition of several common lunar minerals, forming a rough, elongated “bullseye” pattern across thousands of kilometers.

What was the impact? Given the vast size of the basin, it is near-certain that the impact excavated and melted huge volumes of lunar mantle materials. Our observations demonstrate exactly where these are currently exposed at the surface. These materials exhibit a different mineralogy than predicted by several prevalent lunar evolution models. We also observed an extensive volcanically resurfaced region in the basin center. It is compositionally distinct from known lunar magmas, suggesting a previously unknown melting process linked to the geophysical effects of this massive impact basin.

Why does it matter? Understanding how and why impacts trigger volcanic activity is critical for developing strategies to survive future impacts on Earth. Exposed mantle rocks on the Moon's surface may represent the most accessible mantle materials in the solar system. Retrieval or remote study of such materials can further our understanding of the behavior and evolution of planetary interiors.

Moriarty III, D. P., & Pieters, C. M. (2018). The Character of South Pole-Aitken Basin: Patterns of Surface and Subsurface Composition. *Journal of Geophysical Research: Planets*, 123(3), 729-747.



Zone	Description
SPA Compositional Anomaly (SPACA)	Unusual volcanic resurfacing material
Mg-Pyroxene Annulus	Exposed/melted mantle
Heterogeneous Annulus	Mixed, ejected materials (crust and mantle)
SPA Exterior	Exterior crust