

Update on the South Pole-Aitken Geomorphological Map. C. M. Poehler¹, M. A. Ivanov², C. H. van der Bogert¹, H. Hiesinger¹, and J. W. Head³, ¹Institut für Planetologie, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Str. 10, 48149, Münster, Germany, c.poehler@uni-muenster.de, ²Vernadsky Inst., RAS, Russia, ³Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI 02912 USA.

Introduction: The lunar South Pole-Aitken Basin region is an area of high interest for future and ongoing space missions. Several regions located within the SPA are possible destinations for robotic and human missions [e.g. 1–4]. Therefore, detailed studies of the geological background and setting of the region are necessary. The SPA, located on the lunar farside, centered at ~53° S, 191° E, is the largest and probably oldest lunar basin [5,6]. The entire region is widely influenced by rays of the young Orientale basin [7]. The age and extent of SPA makes it a prime target for scientific as well as commercial missions.

In this study, we have mapped the full extent of the SPA basin, covering the South Pole, and extending the map eastward to include part of Orientale basin. Here, we present updates and improvements to the maps since [8]. Altogether, this provides a comprehensive overview of the geology of the region (*Fig. 1*).

Methods: Extending the map of the Apollo basin [9], this map is part of the PLANetary MAPPING (PLANMAP - H2020 n°776276) project. We performed most of the mapping on Lunar Reconnaissance Orbiter (LRO) Wide-Angle Camera images (WAC) (100 m/pixel). In some cases we took the more detailed, images of the Narrow-Angle Camera (NAC; 0.5 m/pixel) [10] and Kaguya (10 m/pixel) data with different incidence angles to look at smaller areas and details. We also used Lunar Orbiter Laser Altimeter (LOLA) digital elevation models (DEMs) and a LOLA/Kaguya merged DEM with a resolution of 59 m/pixel [11] for identifying topographic features. As this map covers partly and permanently shadowed regions in the southernmost latitudes, we produced hillshade maps with various illumination conditions to determine the morphology there. A hillshade image also provides the basemap of the final map. We used PLANMAP mapping standards [12], an extension of USGS standards [13].

We identified geomorphological units on the basis of morphological appearance, albedo contrast and topographic expression. In addition to relative dating of geologic units, we performed crater size-frequency distribution (CSFD) measurements and from these determined absolute model ages (AMAs) using the production and chronology functions of [14]. The final stratigraphic correlation chart uses the morphological relations of units as well as absolute model ages to anchor the stratigraphy to the global geologic history.

Geology: A general description of the geological units and mapping process is given by [8]. Here, we present the improvements and updates done to the map since it was last presented.

The most significant update to the map has been an increase in number of units. We have been able to add several new units due to additional crater size-frequency measurements we made over the mapping area, further subdividing the previous geological units. This provides a more detailed look at the stratigraphy and how the area evolved over geological history. The newly added geological units mostly are Eratosthenian in age making for a more well-defined and diverse recent history than previously described.

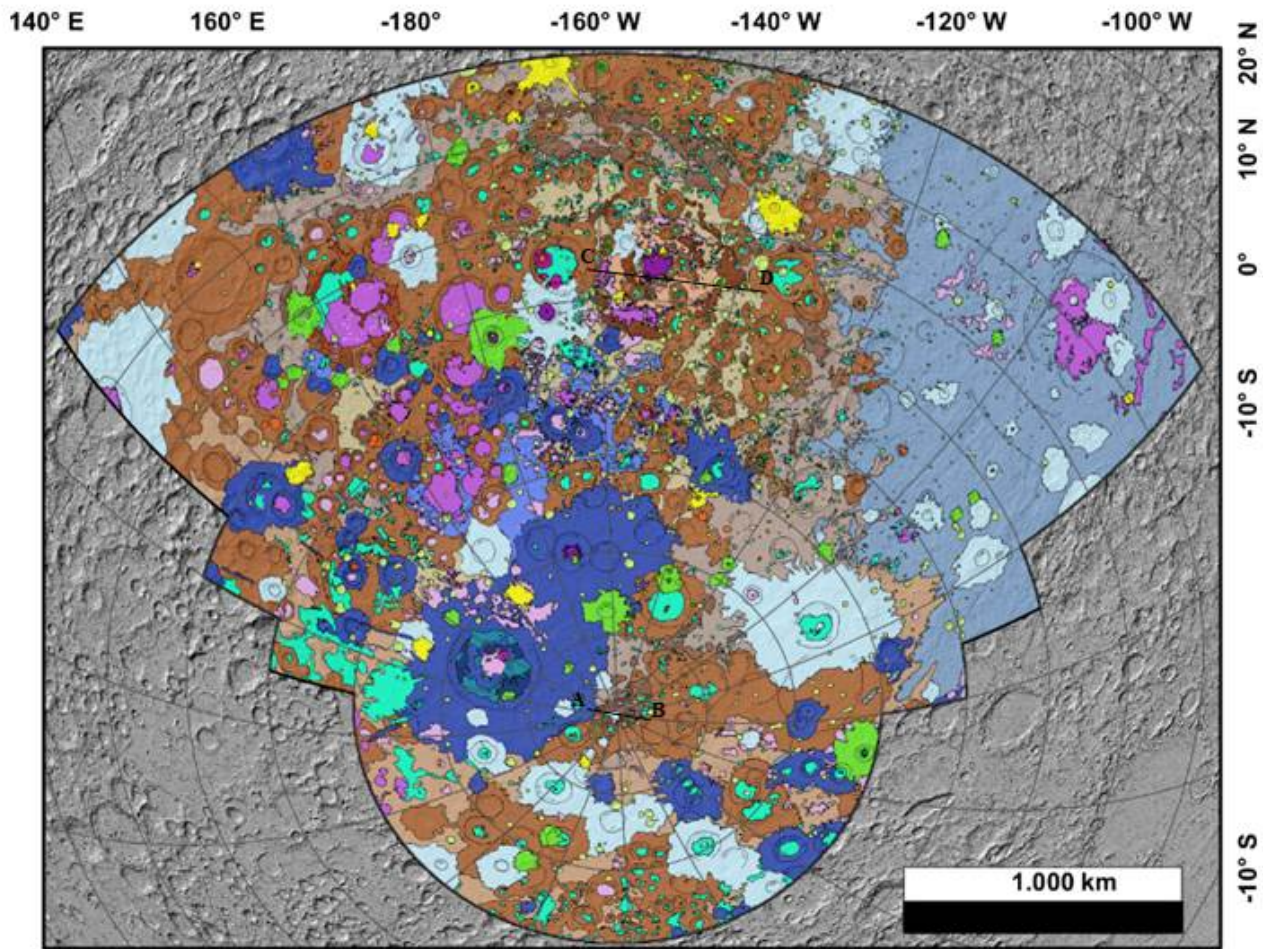
As this map covers a significant part of the Moon (stretching over the pole and extending more northward on the farside), it presents some challenges to traditional display approaches: we therefore increased the map area and made it more symmetrical, now covering the farside up to 10°S and the nearside up to 60°S.

We also updated and added four geological cross-sections (South Pole, Schroedinger Basin, Apollo Basin and a N-S Profile Leibnitz to Poincaré craters) in order to provide a more comprehensive and representative interpretation of the geology of the SPA Basin.

Minor changes included color changes of units to enhance comparison to other lunar maps and an increase of detail in some areas, as well as reassessment and updates of some contacts.

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Geological units

- Ca** Copernican crater materials: Sharp rim craters with prominent ejecta and ray systems.
- Er** Eratosthenian crater materials: Sharp rim craters with prominent ejecta without rays.
- ErL** Eratosthenian light plains: High albedo, smooth plains (potential cryovolcanic).
- ErD** Eratosthenian dark plains: Low albedo, smooth plains (volcanic).
- Upl** Upper Imbrian light plains: High albedo, smooth plains (potential cryovolcanic).
- UplD** Upper Imbrian dark plains: Low albedo, smooth plains (volcanic).
- UplG** Upper Imbrian dark matter: Low albedo, fine grained material with dome like structure (volcanic).
- UplC** Upper Imbrian crater materials: Sharp rimmed crater rims without ejecta and rays younger than Orientale.
- Or** Orientale light plains: High albedo smooth plains accreting mostly as crater fill.
- OrD** Lower Imbrian Orientale materials: Undivided Orientale ejecta.
- OrS** Lower Imbrian Schrodinger floor materials: Presumably impact melt.
- OrSOM** Lower Imbrian Schrodinger rough hummocky floor materials.
- OrSOM** Lower Imbrian Schrodinger smooth hummocky floor materials.
- OrS** Lower Imbrian rolling plains (presumably volcanic).
- OrD** Lower Imbrian crater materials: Sharp rimmed crater rims without ejecta and rays older than Orientale.
- Nect** Nectarian pre-Nectarian crater materials: Large craters with mostly complexed rim and widely merging ejecta.
- preN** Pre-Nectarian igneous materials: Rim material of impact basin.
- preN/A** Pre-Nectarian Apollo floor materials: Presumably impact melt.
- preN/A** Pre-Nectarian Apollo rim materials: Elongated and sub-parallel ridges with blocky and heavily cratered surface.
- preN/A** Pre-Nectarian SPA rim materials: Undivided rim material.
- preN/A** Pre-Nectarian SPA rim materials: Undivided rim material at topographic high.
- preN/A** Pre-Nectarian SPA rim materials: Topographic ridge like features within the SPA rim topographic domains.
- preN** Pre-Nectarian terra material.

SYSTEM	Crater materials	Plains materials	Other	Basin materials					
				Oriente	Schrodinger	Apollo	South Pole-Aitken		
Copernican	Ca								
Eratosthenian	Er	ErL	ErD						
Upper Imbrian	Upl	UplD	UplG						
Lower Imbrian	UplC			Or	OrS	OrSOM	OrS		OrD
Nectarian	Nect								
pre-Nectarian									

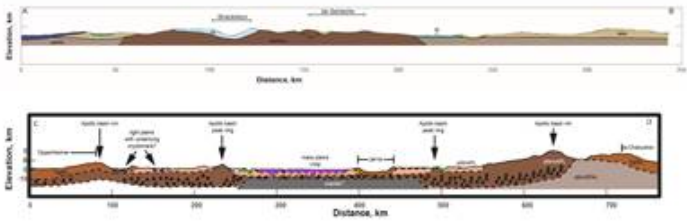


Fig. 1. Updated Geomorphological Map of the Lunar South Pole-Aitken Basin Region with stratigraphic correlation chart of the units and geological profiles of the South Pole and the Apollo Basin.