EPSC Abstracts
Vol. 15, EPSC2021-646, 2021
https://doi.org/10.5194/epsc2021-646
Europlanet Science Congress 2021

Geological Mapping of the South Pole-Aitken Basin Region

Claudia Pöhler[1], Carolyn van der Bogert[1], Harald Hiesinger[1], Mikhail Ivanov[2], and James Head[3]
[1]WWU Münster, Institut für Planetologie, Germany (c.poehler@uni-muenster.de)
[2]Vernadsky Institut, RAS, Russia
[3]Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI 02912 USA

Introduction: The South Pole-Aitken (SPA) basin is located on the lunar farside. Centered at ~53° S, 191° E the SPA is the largest observable basin on the Moon [1-5]. The SPA Region in general and the South Pole in particular are high priority targets for ongoing and future robotic and human missions [e.g., 6–10]. The area potentially includes exposed mantle material [14, 15], sources of volatiles (e.g., pyroclastic deposits [11]), and permanently shadowed regions around the South Pole that may harbor ice or other volatiles [12]. As the oldest lunar basin, the timing of SPA formation gives valuable information on the formation and evolution of the lunar crust [11,13]. These missions make detailed studies of the geological history and setting of the region necessary. Here, we provide a geologic map at a scale of 1:500,000 of the SPA basin region, including the South Pole region which is an extension of a map of the Apollo basin region [13]. Our map provides a comprehensive overview of the geology in the region.

Methods: We used the Lunar Reconnaissance Orbiter (LRO) Wide-Angle Camera (WAC) basemap (100 m/pixel) for the majority of the mapping. To look at smaller areas and to identify specific features, we then also used Narrow Angle Camera (NAC; 0.5 m/pixel) [14] and Kaguya (10 m/pixel) data. Spectral information was taken from Clementine [15], M3 [16], and Kaguya MI [17] data. We determined the topographic features using Lunar Orbiter Laser Altimeter (LOLA)/Kaguya merged digital elevation models with a resolution of 59 m/pixel [18] where available. For higher latitudes we used LOLA digital elevation products [19, 20]. At the poles we mitigate the effect of low solar illumination angles, which cause significant shadows, by producing hillshade maps with various illumination conditions.

We worked according to PLANMAP mapping standards [21], an extension of USGS standards [22].

With the available data we identified different units and features based on their morphological appearance, albedo contrasts and, if applicable, spectral signal. We then established a relative stratigraphy for these units using morphological and stratigraphic evidence. Next, we performed crater size-frequency distribution (CSFD) measurements and determined absolute model ages (AMAs) using the production and chronology functions of [23] to put constraints on the chronology. CSFD measurements were made using CraterTools [24] in ArcGIS, and fit with Craterstats [25]. The technique is described in detail by [23, 26].

Geology: In this map, we cover the full extent of the SPA basin. We were able to identify the rim of SPA basin, which presents itself best in the elevation data. Due to its old age, however it remains difficult to identify original rim units. Best preserved in the NE part of SPA basin the rim makes up a two ring structure. While in most of the other segments of the rim, the rim itself is covered by younger geologic units.

We extended our map to the East from the central SPA basin to include a large part of Orientale basin. Due to the size and proximity to the SPA basin, Orientale basin has had a modifying influence on large parts of SPA basin. The whole area is covered in small, sharp-rim craters some of which form crater chains and clusters. A plausible origin for most of these small sharp-rim craters could be the Orientale basin. The area also exposes extensive light plains of which some might also coincide with the formation of Orientale basin.

Acknowledgments: This paper is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº776276 (PLANMAP) and N°871149 (GMAP).

References: [1] Stuart-Alexander (1978) USGS Map I-1047. [2] Spudis et al. (1994) Science 266, 1835-1839. [3] Hiesinger and Head (2004) PLPSC 35, 1164. [4] Shevchenko et al. (2007) Solar Sys Res 41, 447-462. [5] Garrick-Bethell and Zuber (2009) Icarus 204, 399-408. [6] Flahaut et al. (2020) PSS 180, 104750. [7] Steenstra et al. (2016) Adv Space Res 58, 1050–1065. [8] Allender et al. (2018) Adv Space Res 63, 692–727. [9] Hiesinger et al. (2019) LPSC 50, 1327. [10] Huang et al. (2018) JGR 123, 1684 – 1700. [11] Wilhelms (1987) USGS SP-1348, 302. [12] Nozette et al. (2001) JGR 106, 23253– 23266. [12] Hiesinger et al. (2012) LPSC 43, 2863. [13] Ivanov et al. (2018) JGR 123, 2585–2612. [14] Robinson et al. (2010) Space Sci Rev 150, 81–124. [15] Pieters et al. (1994) Science 266, 1844–1848. [16] Isaacson et al. (2013) JGR 118, 369–381. [17] Ohtake et al (2013) Icarus 226, 364–374. [18] Barker et al. (2016) Icarus 273, 346-355. [19] Smith et al. (2010) Icarus 283, 70-91. [20] Smith et al. (2010) GRL 37, L18204. [21] wiki.planmap.eu/display/public/D2.1-public. [22] FGDC (2006) FGDC-STD-013-2016. [23] Neukum et al. (2001) Space Sci Rev 96, 55–86. [24] Kneissl et al. (2011) PSS 59, 1243–1254. [25] Michael and Neukum (2010) EPSL 294, 223–229. [26] Hiesinger et al. (2000) JGR 105, 29239–29276.