LUNAR MARE BASALTS IN- AND OUTSIDE OF THE SOUTH POLE-AITKEN BASIN. J. H. Pasckert[1], H. Hiesinger[1], and C. H. van der Bogert[1]. [1]Institut für Planetologie, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany. jhpasckert@uni-muenster.de

Introduction: While the lunar nearside is dominated by mare volcanism, the farside shows only isolated mare deposits in the large craters and basins, like the South Pole-Aitken (SPA) basin or Tsiolkovsky crater [e.g., 1-4]. Although the SPA basin is the largest (>2000 km in diameter) observed impact structure on the Moon [e.g., 4], and might have even penetrated the entire lunar crust, only a relatively small amount of the basin has been flooded by mare basalts (Fig. 1), compared to the large nearside basins (e.g., Imbrium). To understand the volcanic evolution of the SPA basin, we mapped 103 mare deposits (Fig. 1) on the basis of Wide Angle Camera (WAC) data obtained by the Lunar Reconnaissance Orbiter (LRO).

Basaltic volcanism on the lunar nearside was active for almost 3 Ga, lasting from ~3.9-4.0 Ga to ~1.2 Ga before present [5]. In contrast to the nearside, most eruptions of mare deposits on the lunar farside stopped much earlier, ~3.0 Ga ago [6]. However, [6] also found mare deposits that show much younger ages of 2.5 Ga. Consequently, [6] concluded that the farside volcanism might have occurred episodically, around 2.5 Ga and between 3.0 Ga and 3.6 Ga. However, they pointed out that the absence of volcanic deposits with ages between 2.5 and 3.0 Ga might also be explained by continuous resurfacing by the younger deposits. Absolute model ages (AMAs) of the SPA basin mare basalts, also derived by [6], range from 2.44 Ga (Apollo S) to 3.85 Ga (mare inside Nishina crater), which covers the whole range of ages of the lunar farside basalts. Thus, [6] argued that the relatively large difference in the cessation of volcanic activity between the nearside (1.2 Ga) and farside (2.5 Ga) might be related to a larger crustal thickness on the lunar farside, which hinders eruptions. But, according to the crustal thickness map of [7], based on new high-resolution gravity data obtained from the Gravity Recovery and Interior Laboratory (GRAIL), the crustal thickness in the SPA basin is thinner than 25 km, similar to the crustal thickness of the lunar nearside mare.

The absolute model age of the SPA basin itself has been derived by [8] on the basis of WAC data. Their crater size-frequency distribution (CSFD) measurements indicate an absolute model age of ~4.26 Ga, which is ~400 Ma older than the oldest mare basalts measured inside the SPA basin by [6].

Data: We used data from the LRO Wide Angle Camera (WAC: 100 m/pixel) and Narrow Angle Camera (NAC: 1 m/pixel) to identify and map individual volcanic deposits and to perform crater size-frequency distribution (CSFD) measurements. The combination of the global WAC mosaic with the FeO map of [9] (100 m/pixel) based on Clementine data, was used to identify and map individual basaltic deposits. In addition, we used the digital terrain model derived by the Lunar Orbiter Laser Altimeter (LOLA) [10] with a horizontal resolution of 100 m/pixel to investigate the elevation of the mapped mare basalts.

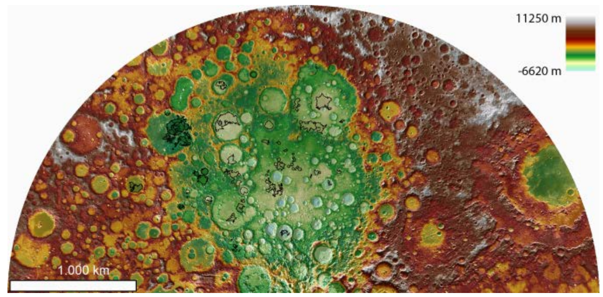

Figure 1: Topographic map of the SPA basin (LOLA DTM) in south polar stereographic projection. Mapped mare basalts are indicated in black.

Results: Most of the mapped mare basalts are located in impact craters of different sizes, e.g., Ingenii, Apollo, and Hess. However, in the center of the SPA basin at the deepest elevations, there are some mare basalts not related to impact craters. To date we derived absolute model ages for 50 individual mare basalts of the volcanic deposits we mapped during this study (103) by performing CSFD measurements on WAC images. Our model ages range from 3.24 Ga (+0.14/-0.38 Ga), for the mare basalts inside Jules Verne crater at the western rim of the SPA basin, to 3.84 Ga (+0.05/-0.08 Ga) for mare basalts north of Gravito crater (Fig. 2a). A large number of secondary craters and the burial of mare basalts by the ejecta of relatively large Eratosthenian impact craters, like Finsen (80 km in diameter), makes it difficult to define good counting areas for reliable ages inside all the mapped mare basalts. Hence, 53 of the 103 mapped basalts have been temporarily excluded from the results.

Our absolute model ages are generally very similar to the absolute model ages of the mare basalts inside the SPA basin derived by [6]. For example, [6] obtained an absolute model age of 3.34 Ga for the mare basalts inside Jules Verne crater, which is within our error bars. However, [6] found some younger ages between 2.44 Ga and 2.58 Ga; these ages seem to be resurfacing ages in the most cases. We did not see evidence of resurfacing events with such young ages in our counts, possibly due to the difference in image resolution. We used WAC data (100 m/pixel), whereas [6] used SELENE Terrain Camera data (10 m/pixel).

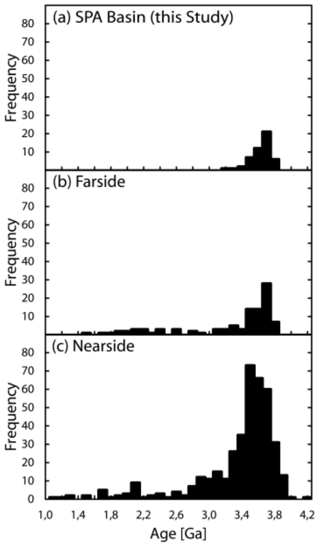

Figure 2: (a) Absolute model ages derived in the current study of mare basalts in the SPA basin, **(b)** ages of all investigated mare basalts on the lunar farside from [6], [11], [12], [13], [14], and this study. **(c)** ages of mare basalts on the lunar nearside [5]. The young volcanic activity at ~2.0 Ga occurring on the near- and farsides does not appear to occur in the SPA basin.

We also estimated the FeO content of each mare basalt unit with the FeO map of [9], revealing a range between 14 and 20 wt% with an average of 18 wt%. This is generally very similar to the mare basalts investigated by [14] and [e.g., 9]. A trend between the absolute model ages and the FeO content was not observed (Fig. 3a).

We also compared the absolute model ages of the mare basalts with the crustal thickness in the SPA basin. Comparing the crustal thickness map (Fig. 4) and the LOLA DTM (Fig. 1) shows, that to a first order, the topography reflects the crustal thickness in the SPA basin. Hence, we measured the mean elevation of each dated mare basalt as a proxy for crustal thickness and compared it to the respective model age (Fig. 3b). However, a trend between the AMAs and the elevation was not observed (Fig. 3b).

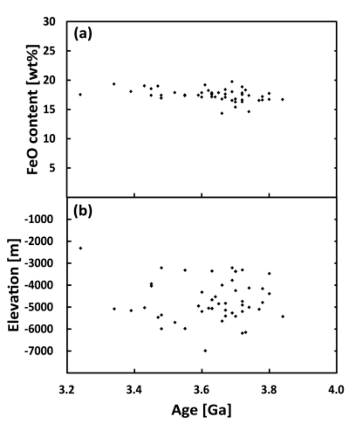

Figure 3: Correlation between the absolute model ages of the investigated SPA basalts and the respective FeO content **(a)** and the elevation **(b)**. We do not see any trends either between the age and FeO content, or the age and the elevation.

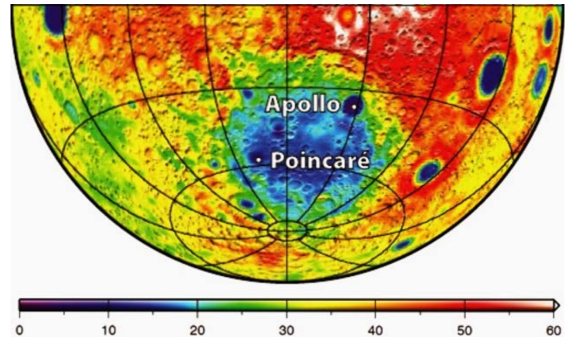

Figure 4: Crustal thickness map of the SPA basin, modified from [7].

Discussion and Conclusions: According to [11-14], other farside mare basalts show AMAs from 1.5 Ga to 3.9 Ga. Our preliminary results show, that the SPA basin has been volcanically active over at least 600 Ma from 3.2 Ga to 3.8 Ga (Fig. 3a). Although the SPA basin contains the largest occurence of mare basalts on the lunar farside and globaly excavated deepest into the crust, it does not schow evidence for such long periods of volcanic activity known from other lunar basins. Our AMAs are generally very similar to the AMAs obtained by [6]. Comparing the histograms of the near- and farside in figure 2, shows that the general shape of both histograms seems to be much more similar than previously thought. On both sides we see a clear peak of volcanic activity between 3.4 Ga and 3.8 Ga and also a second peak at about 2.2 Ga (Fig.2). However, farside and nearside differ in the absolute amount of volcanic activity as well as the younger activity on the nearside (nearside:1.2 Ga; farside:1.5/1.7 Ga). The gap of 400 Ma between the formation of the SPA basin and the oldest volcanic activity inside the basin might be explained, as [6] already proposed, by the burial of older lava flows by younger flows or ejection. Thus, we do not see lava flows older than 3.8 Ga on the surface. Nevertheless, the absence of lava flows younger than 3.2 Ga is surprising, because [11-14] found much younger absolute model ages (1.7 Ga to 3.2 Ga) of mare basalts on the lunar farside outside of the SPA basin in regions with greater crustal thicknesses. We do not see a correlation between the elevation of the mare basalts and their absolute model ages inside the SPA basin (Fig. 3b). This leads us to the conclusion, that crustal thickness might not be the only or most important factor to explain why volcanic activity stopped earlier on the lunar farside than on the nearside, as proposed for example by [6,15].

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