**THE LIGHT PLAINS OF THE LUNAR NORTHERN REGION (45°-90°N).** C. M. Poehler[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 (c.poehler@uni-muenster.de).

**Introduction:** Lunar light plains are high albedo, morphologically smooth plains typically situated in the highlands [1]. Since their morphology is similar to dark mare plains, a volcanic origin for them was proposed [2]. However, the Apollo 16 mission revealed that light plains consist mostly of impact breccias [3]. This led to several new hypotheses proposing an origin by one or two basin-forming events or several local impact events, and the deposition of fluidized ejecta [e.g. 1,4,5,6]. Meanwhile, other studies continued to support a volcanic origin [7,8]. Here, we determined the absolute model ages (AMAs) of light plains in the northern hemisphere to expand on existing data for light plains close to the equator [7], in the southern hemisphere [9], on the northern nearside [8], and around Orientale basin [10].

**Method:** We used Lunar Reconnaissance Orbiter Wide Angle Camera image data (100 m/pixel) [11] to identify and characterize the light plains. The study area extends from the north pole to 45°N (***Fig. 1***). Shadowing effects prohibited light plains identification above 80°N latitude. On the nearside, mare basalts in Mare Frigoris and Oceanus Procellarum cover the area up to about 60°N. We performed crater size-frequency distribution measurements (CSFD) and determined absolute model ages (AMAs) using the production and chronology functions of [12]. The CSFD measurements were made using Crater Tool [13] in ArcGIS, and we used Craterstats to determine the corresponding AMAs [14]. Detailed descriptions of the CSFD measurement technique are given by [12,15,16]. The light plains units chosen for CSFD measurements were carefully examined for homogenous surfaces and special care was given to excluding secondary craters.

**Results:** We determined AMAs for 24 light plains occurrences. The light plains show AMAs ranging from 3.43 +0.096/-0.28 to 3.98 +0.019/-0.022 Ga (***Figs. 1, 2***). The light plains were divided into three different units lp, lp1, and lp2 by [17]. Unit lp1 was described as the older stratigraphic light plains unit with more craters than the younger lp2. Light plains that cannot be distinguished into an older or younger unit were grouped as lp [17]. We measured eight occurrences for each lp type.

Plains type lp1 shows the lowest (3.43 Ga) and oldest (3.98 Ga) AMAs. Some areas show signs of resurfacing in their CSFD measurements. For example, in Area 12 (61.1°N, 121.2°W), the light plains in a 40-km diameter crater gives two ages: 3.98 (+0.06/-0.071) Ga, representing an underlying older surface, and 3.43 (+0.096/-0.28) Ga, interpreted as the emplacement age of the light plains. Craters with a diameter smaller than 400 m appear to be in equilibrium. Two other areas also give two ages for the underlying surfaces: 3.93/3.60 Ga and 3.72/3.64 Ga. The older ages could indicate the presence of underlying cryptomare.

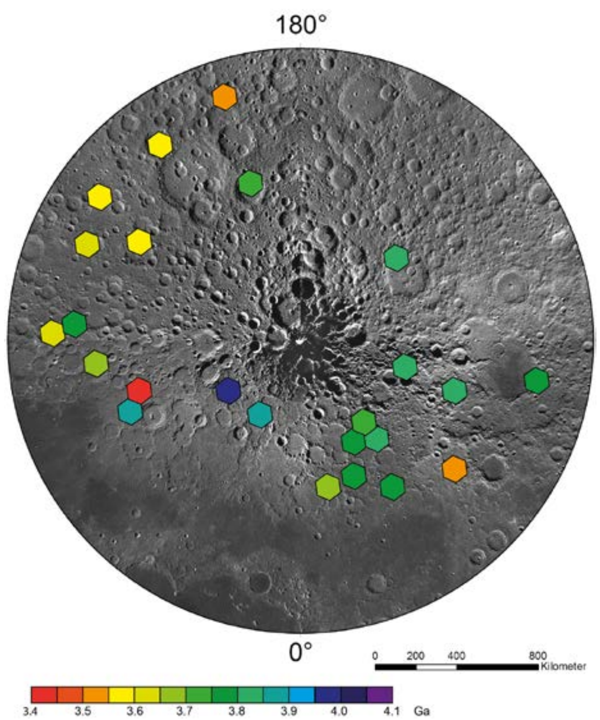


***Fig. 1.*** *Locations and absolute model ages (AMAs) for light plains units in our study region from 45°N-90°N shown on LRO WAC mosaics [NASA/GSFC/ASU].*

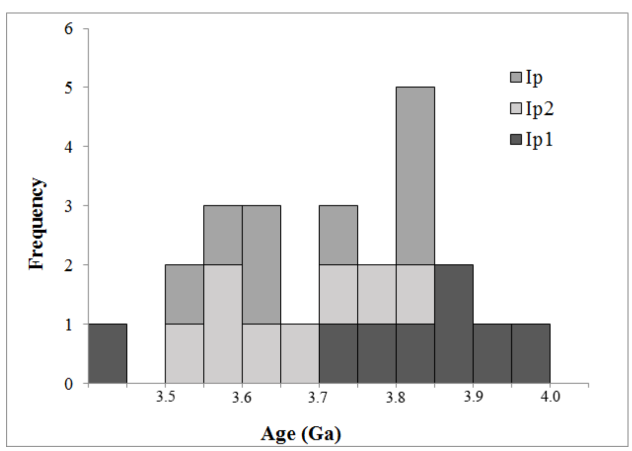


***Fig. 2.*** *Age distribution of light plains AMAs in the northern lunar hemisphere.*

From the areas mapped as lp1, four occur as crater fills and four are on intercrater plains. Some of the areas mapped as lp1 show CSFDs that can be easily fit to derive an AMA. The other areas mapped as lp1 seem to be either (1) affected by secondary cratering, which appears as small bulges in the cumulative CSFDs, or (2) exhibit equilibrium at small crater diameters.

The lp2 plains type occurs mostly on the nearside and to the east of the lp1 units. Areas mapped as lp2 show AMAs between 3.51 and 3.84 Ga. Five of the light plains fill large craters; the other three are intercrater plains. While lp2 was proposed to be younger than lp1 [17], the ages obtained in this study do not confirm this stratigraphic relationship, because both unit types span about the same time interval. However, some differences can be observed in small-scale areas.

Two areas directly east of Meton crater were selected to look at the small-scale age differences between the different types of light plains units. These areas border each other and were mapped as lp1 and lp2 [18]. Ages obtained for these plains show a younger AMA of 3.71 +0.025/-0.03 Ga for the lp2, whereas the AMA for the lp1 is 3.84 +0.32/-0.42 Ga. Thus, in this case we can confirm a stratigraphic relationship where lp2 is younger than lp1. On a larger scale, as shown in Fig. 2, this stratigraphy could not be supported since both Ip1 and Ip2 include light plains of both older and younger ages.

Overall, the ages are for the most part evenly distributed over the study area (***Fig. 1***). There is a slight ordering effect with ages between 3.7 and 3.8 Ga seeming to cluster in the east, whereas the most western light plains are slightly younger (3.6 Ga). The oldest light plains are generally found close to the pole.

**Discussion:** The two youngest large basins the Moon are Orientale (3.68-3.8 Ga [18,19]) and Imbrium

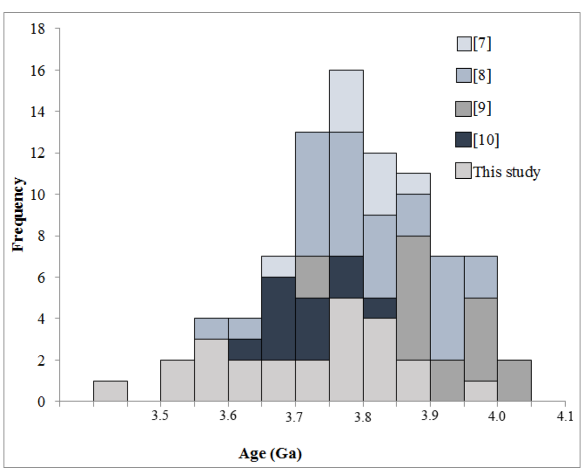


***Fig. 3.*** *Distribution of light plains AMAs in this study combined with [7,8,9,10].*

basin (3.85 Ga [18]).The long time span over which the light plains of the study area formed excludes an origin by one or even two major events. With several light plains postdating the formation of the youngest basin (Orientale), an origin solely via basin forming events can also be excluded. Nevertheless, our data shows a peak in the number of plains formed around 3.8 Ga. This peak becomes even more significant when combining our data with previous AMA determinations in other areas of the Moon (***Fig. 3***) [7,8,9,10]. The peak in ages around 3.8 Ga correlate to Orientale and possibly Imbrium basin formation, which might indicate a contribution to the formation of light plains by these events either directly as ejecta or by triggering volcanism in those areas.

To investigate a potential volcanic origin of the light plains, we looked for volcanic features in the light plains in our study. While we were able to identify some structures that could be wrinkle ridges and might be linked to volcanic activity, most light plains in the study area did not show any evidence of typical volcanic features.

On the basis of all available CSFD measurements [7-10, this work], it appears that light plains in the northern hemisphere might be younger than those in the southern hemisphere. In addition, light plains in the western hemisphere seem to be younger than those in the eastern hemisphere. This supports an origin related to the Orientale basin for these light plains units.

**Conclusions:** The absence of volcanic features in the areas we studied supports an impact, rather than a volcanic origin for light plains materials. The broad range of ages for light plains across the Moon precludes an origin via a small number of basin-forming events. Nevertheless, groupings of ages are likely associated with particular basin events, such as Orientale.

*Acknowledgements:* This project receives funding from the European Union Horizon 2020 research and innovation programme under grant agreement No 776276.

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