DIFFERENT AGES OF LUNAR LIGHT PLAINS. Gerhard Neukum, Institut für Allgemeine und Angewandte Geologie der Universität München, W.Germany and Max-Planck-Institut für Kernphysik, Heidelberg, W.Germany.

1. SUMMARY. The crater populations of 15 lunar light plains show a variation in relative ages by a factor of \( \approx 4 \) in crater frequency of regions in the surroundings of the Orientale resp. Imbrium basin, and by a factor of \( > 10 \) for more distant sites. Many light plains are younger than the youngest basin Orientale. Since these plains cannot have been emplaced by any basin event and local impact-derived origin can certainly be excluded, an endogenic origin is proposed. Age determination data by Soderblom and Lebofsky (1) and Soderblom and Boyce (2) are shown to be correlated with own cumulative crater frequency measurements for surfaces younger than \( \approx 3.8 \times 10^9 \) years. For ages \( > 3.8 \times 10^9 \) years the DL data by (1) and (2), especially those for the light plains, are clearly incompatible with our crater frequency data. In some cases, the DL data are demonstrably inconsistent.

2. RELATIVE AGES OF LUNAR LIGHT PLAINS: DATA. The origin of the light plains has been subject to continuous debate. Though believed volcanic in origin prior to the A 16 landing, formation by ejecta deposition from multi-ringed basins (3, 4) or in situ as impact melt (5) were favored as modes of emplacement after the A 16 landing. For answering the question of the origin of the lunar light plains, the derivation of the chronology of their emplacement is an obviously important matter. Their genetic relationship to any basin event is only possible if contemporaneity is found. The crater populations of 16 lunar light plains mainly in the surroundings of the Orientale and Imbrium basin were measured, additionally in two farside regions (6 and this work). Fig. 1. shows part of the data and the clear variation in crater frequency by a factor of \( > 10 \). For comparison the Orientale and Imbrium basin "event" curves (6) are given. The light plains floor of crater Mendeleev is clearly younger than the A 16 LS light plains or the Imbrium basin. The light plains in the floor of Albategnius and Van de Graaff are clearly younger than the youngest lunar ringed basin Orientale. (Considering the fill of Van de Graaff a light plains filling and not a mare filling may be debatable. Therefore, the Van de Graaff data are not any further included in the discussions). The light plains south of the Fra Mauro Formation have been studied in detail (Fig. 2). Their crater frequencies vary by a factor of about 2.5, lying below or right at the Imbrium basin event frequency (which is identical with the Fra Mauro Formation frequency (6)). The average crater frequency of all areas combined lies clearly below the Imbrium event frequency, which means that on the average these areas are younger than the Imbrium basin. In histogram of Fig. 3, our cumulative crater frequency data taken at \( D=1 \text{km} \) by application of our standard (calibration) size distribution (7) are displayed. All light plains investigated except Mendeleev \( \approx \) old or younger than the Imbrium basin, and 6 plains are even younger than the Orientale basin. Since the accuracy of the measurements is about \( \pm 30\% \), it cannot be excluded that some areas with crater frequency values close to that of Orientale (Nos. 2, 6, 8, 10 in Fig. 3) were formed contemporaneous with Orientale. But three sites (Nos. 11, 13 and 14 in Fig. 3) were formed clearly more recently than the Orientale basin. Among those is the Albategnius filling (No. 11 of Fig. 3), remarkable because of its neighborhood to Ptolemaeus whose filling is older by a factor of about 3 in crater frequency which corresponds to a difference in
absolute age of about 200 m.y. (6,8). The difference between the youngest and the oldest light plains surrounding Imbrium and Orientale is about a factor of 4 in crater frequency corresponding to about 250 m.y., the difference in crater frequency between the youngest light plain in Fig.3 (Albateigius filling) and the filling of the farside crater Mendeleev is a factor of ≈ 10, corresponding to an age difference of 400 m.y. Our data clearly show that the lunar light plains formed over an extended period of time. Many light plains areas seem to have formed subsequent to the basin impacts Imbrium and Orientale, as if some activity was triggered by these events. However, the age distribution of Fig.3 is not necessarily representative because of special area selection.

3. COMPARISON AND DISCUSSION OF RESULTS. Soderblom and Boyce (2) inferred a moonwide synchronous formation of the light plains from their measurements of the erosional states of craters in these areas (DL values, cf. (1,2,9)). They found appr. the same DL values for all light plains investigated which meant that all these areas had experienced the same accumulated flux, i.e. crater frequency. Later (9) they modified their results pointing out two age groups of light plains related to the Imbrium and Orientale event, respectively. Their conclusions are in clear contradiction to our data. Since we have in part investigated the same areas, we have been able to plot their DL values and those by Soderblom and Lebofsky (1) in correlation with our cumulative crater frequency values as shown in Fig.4. For the data with N-values < 10^-2, an approximate correlation DL ∝ N^0.6 can be derived. The correlation DL ∝ N maintained by (1,2) does clearly not hold. For N > 10^-2, the DL values for different light plains areas are essentially constant around 550, whereas our data for the same areas vary as discussed before (Fig.3). Only the DL values for A14 LS and Meton floor are compatible with our measurements and fall on the correlation line DL ∝ N^0.6. The inconsistency of their measurements becomes evident by visually comparing the crater frequency at e.g. the Ptolemaeus site (No. 10 in Fig.4) with that at the Mendeleev site (No. 15 in Fig.4). The battered Mendeleev floor appears clearly older than the smooth relatively unimpacted Ptolemaeus floor just by visual inspection (10). A reason for the failure of the DL method for ages in excess of ≈ 3.8×10^9 years may be its inherent limitations. The method was derived only for a constant slope of -3 in the log-log plot of the cumulative production size-frequency distribution (which is the case only in the size range ≤ 500 m (7)) and fails for slopes approaching -4 (11). This is the case for 0.8 < D < 1.5 km (7), where the measurements for the light plains DL values were obtained.

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