AGE RELATIONS OF GEOLOGIC UNITS IN THE GRUITHUISEN REGION OF THE MOON BASED ON CRATER SIZE-FREQUENCY MEASUREMENTS; R. J. Wagner[1], J. W. Head[2], III, U .Wolf[1], G. Neukum[1], [1]DLR, Institute of Planetary Exploration, Rudower Chaussee 5, D-12489 Berlin, Germany; [2]Department of Geological Sciences, Brown University, Providence, Rhode Island, USA.

Data base. All measurements of crater size-frequency distributions were carried out on Lunar Orbiter V high resolution images from orbits LOV 183, 184 and 185 and on image LOV 182 M with medium resolution. The images were photographically processed and used as transparencies in a size of 25 by 25 cm. Photogeologic units on the images were identified using albedo and morphology as primary criteria.

Method. All crater size-frequency measurements were carried out using a Zeiss PS2K stereocomparator with a resolution of 25 µm. The scale on each transparency in kilometer / centimeter is determined from [3] which provide all necessary navigational data for each Lunar Orbiter image. The crater counting method follows the techniques described by [4], [5], [6], [7] and [8]. Crater diameters measured are partitioned into 18 increasing bin diameters for each size range (..., 0.1 - 1 km, 1 - 10 km, ...). From this data set the cumulative size-frequency distribution is constructed [4]. A polynomial of 11th degree, representing the lunar production function, is fitted to each data set [5], [7], [8]. For any two geologic units with different exposure times to the meteorite flux, their respective cumulative densities taken at a certain reference diameter (here: 1 km) are directly proportional to their exposure times and therefore indicate relative age differences [5], [7], [8]. To extract an absolute cratering model age in Giga-years (Ga; 1 Ga = 10^9 years), a cratering chronology curve is used which was derived empirically by [5] from the correlation between crater frequencies and radiometric ages of lunar rock samples. All absolute ages derived from crater counting could be subdivided into six chronologic units showing a one-stage development, and into four units showing a two-stage development. Some counts yielded very uncertain results. Craters may not have been retained very well on slopes, the crater population may be too close to saturation, or areas of measurement may simply be too small. Additionally, areas which could not be counted due to image artifacts, or clusters of secondary craters, were excluded.

Sequence of Events. The oldest units of about 3.8 Ga reflect events starting in Lower Imbrian. Highlands and clusters of large secondaries which were grouped into Upper Imbrian by [2] may be attributed to the Iridum event (Currently, dating the Iridum event by crater counts is in progress). The two

Gruithuisen volcanic domes both have ages ranging from 3.8 - 3.72 Ga which places them into earliest Late Imbrian after the Orientale and Imbrian events. Thus, the domes apparently are older than previously thought [1], [9].

Mare materials are emplaced in at least three stages, the oldest two of them being grouped into Upper Imbrian (3.55 and 3.3 Ga). Isolated smaller maria of Upper Imbrian age are also formed in highland regions. These findings are consistent with [1].

Mare volcanism continues into the Eratosthenian era. Large areas of mare material counted in the Gruithuisen region are roughly 3.0 Ga and younger. These results are contrary to the Imbrian age assumed for these materials by [1], but consistent with [2].

Younger events are not well confirmed by crater counts. They may be related to continuing volcanism (lava flows from the volcanic domes) or mass wasting (landslides). On slopes in highlands, the major cause for crater loss and hence ages which may come out very young is mass movement. Cratering model ages younger than 3 Ga may not be distinguished very well since the cratering rate has attained a nearly constant level [5].

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