ABSOLUTE MODEL AGE ESTIMATES OF THE FECUNDITATIS BASIN AND MARE FECUNDITATIS IN THE REGION OF LUNA-16 LANDING SITE.

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Introduction: The Fecunditatis basin represents a broad topographic depression partly filled by mare basalts. Although these features are typical of impact basins on the nearside, the other characteristics of lunar basins such as multiple rings and a pronounced topographic profile are absent. Although the basin has muted morphological and topographical signatures that provide weak evidence for its presence [1,2], the topographic variations and crustal thickness in this region suggest that the Fecunditatis basin exists and may be among the oldest impact structures on the Moon [3-8].

Analyses of materials delivered to Earth by the Luna-16 sample return mission revealed a variety of absolute radiometric ages that appear to cluster around an ~3.4 Ga value [9-13], whereas crater size-frequency distribution measurements (CSFD) reveal a wider spectrum of absolute model ages in the Fecunditatis basin [14]. In this paper, we present our estimates of the AMAs that are related to both basin and to Mare Fecunditatis.

Method: In order to estimate the AMAs of the major features and units in the region of the Luna-16 landing site we performed CSFD measurements in four key areas: 1) The region within the inferred inner ring [6] of the Fecunditatis basin that includes both the highlands (16,0002 km2) and mare (220,000 km2) domains. In an attempt to estimate the AMA of the basin, we conducted CSFD measurements in these domains separately. In the mare domain, some craters are overlain by mare materials but their presence is marked by specific landforms, for example, circular wrinkle ridges. These (ghost) craters have been included into the population of the mare craters. 2) An area (4x4 degrees, ~13,000 km2), which is centered at the Luna 16 landing point. 3) An irregular-shaped area (~9600 km2) that has the most uniform distribution of FeO and TiO2 determined from the Clementine data [15]. 4) The floor of crater Langrenus (~2,000 km2) whose rays and secondary craters overlay the eastern portion of Mare Fecunditatis.

Results and discussion: *<u>Domains within the inner ring of the Fecunditatis basin.</u>* The CSFD (diameter range 15-40 km) on the highland domain within the inner ring of the basin falls onto the lunar equilibrium curve and does not provide information for the AMA determinations.

Craters larger than ~40 km diameter deviate slightly from the equilibrium curve and their SFD suggests the AMA of ~3.97+0.05/-0.07 Ga (Fig. 1a). The highland domain predominantly represents a portion of the rim and ejecta of the Crisium basin and the 4.10 Ga age likely reflects time of the Crisium basin formation; this age is close to the earlier estimates of the Crisium formation, ~4.07+0.016/-0.018 Ga [2]. The age of the Nectaris basin was estimated as 4.17+0.012/-0.014 Ga [2]. Since the ejecta of the Crisium and Nectaris basins partly overlie the topographic depression of the Fecunditatis basin, it must be older than ~4.17 Ga and thus may represent one of the oldest lunar basins.

The entire measured CSFD in the mare domain cannot be fit by a single isochron and only the distribution of the craters >15 km is poorly fit by an isochron of ~3.81+0.04/-0.05 Ga (Fig. 1a). Because the population of craters within the mare domain includes those that predate the mare emplacement, this estimate should reflect the age of the pre-mare surfaces. In this case, an at least ~160 m.y. (up to ~260 m.y.) difference exists between the ages of the exposed (highlands domain) and hidden (mare domain) portions of the pre-mare surfaces. Such an age discrepancy requires either a single resurfacing event or a series of such events that were sufficiently extensive to partly erase the pre-mare crater population.

<u>Mare Fecunditatis.</u> The CSFD curve for the area around the landing site and in the area with the uniform concentrations of FeO and TiO2 shows two AMAs: 3.45±0.01 Ga for craters in a diameter range from 0.6-2 km and 3.85-3.86 for the larger craters (Fig. 1b,c). The area around the landing site largely corresponds to spectral units F7 and F8 [14], which have AMA estimates of ~3.36 and ~3.59 Ga, respectively. The AMAs of 3.85-3.86 are close o the ages of the mare domain of the inner ring of the Fecunditatis basin (Fig. 1a) and likely reflect ages of the surfaces predating the emplacement of the main portion of Mare Fecunditatis.

<u>Langrenus floor.</u> The crater size-frequency distribution in a diameter range 0.4-1.5 km on the floor of crater Langrenus is close to the AMAs determined in the areas near the landing site, 3.41±0.04 (Fig. 1d). This AMA is completely consistent with the stratigraphic age of Langrenus whose rays and secondary craters overlie the eastern portion of Mare Fecunditatis.

Conclusions: The AMA of ~3.45 Ga for the area around the landing site and in the area of the uniform concentration of FeO and TiO2 is within the range of absolute radiometric ages determined for the particles from the L-16 sample [9-13]. We, thus, conclude that the current Mare Fecunditatis surface in the interior is likely to represent the latter episodes of volcanism, the main phase of which was active ~3.5-3.4 Ga ago

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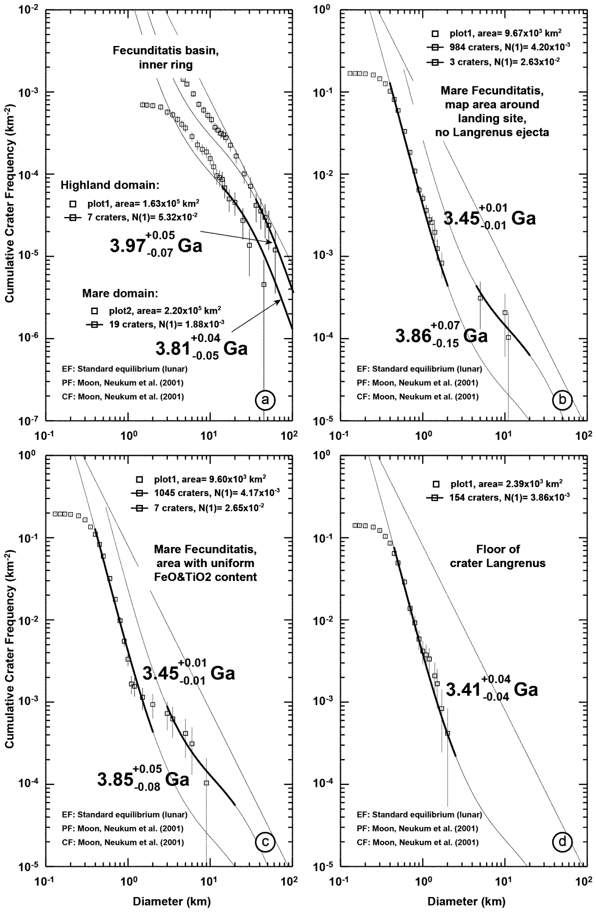

Fig. 1. AMA estimates for different regions of the Fecunditatis basin and Mare Fecunditatis.