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The lunar impact-crater production size-frequency distribution and cratering chronology, revisited

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The lunar cratering chronology as a basis for chronologies and the terrestrial planets and possibly the satellite systems of Jupiter and Saturn (the “lunar reference system”) was reinvestigated in a comprehensive effort by Neukum et al. (2001) [1]. The well-investigated size-frequency distribution (SFD) for lunar craters was used to estimate the SFD for projectiles which formed craters on terrestrial planets and on asteroids. The result shows the great stability of these distributions during the past 4 Gyr. The derived projectile size-frequency distribution is found to be very close (cf. also [2]) to the size-frequency distribution of Main-Belt asteroids as compared with the recent Spacewatch asteroid data and astronomical observations (Palomar-Leiden survey, IRAS data) as well as data from close-up imagery by space missions. It means that asteroids are the main component of the impactor family. Also for small craters ($D \leq 1$ km), the crater size-frequency distribution found on the earth’s moon outside strewn-fields of large primary craters are mainly primary craters formed by small impactors from the asteroid belt [1, 2, 3] and not secondaries as maintained by McEwen et al. [4]. The primary distribution of small impactors is seen in direct measurements of the cratering record on asteroids, such as Gaspra or Ida [3, 5], and which are lunar-like steep distributions. Measurements on young impact craters such as Copernicus, Tycho, North ray crater, Cone crater and South Ray crater [6, 7] also show similar steep distributions whose frequencies relative to each other show ratios proportional to the age ratios of the host craters, thus indicating constant flux for more recent times. In conclusion: 1) The vast majority of small ($D \leq 1$km) impact craters on the moon in the steep part of the distribution are of primary origin and can (outside strewn-fields of

large primaries) be used with confidence for age dating within the statistical uncertainties and tolerable contamination within generally $< 10\%$ by unidentified unwittingly included small secondaries. 2) The lunar cratering chronology is correct very probably within less than $\pm$ 20 % uncertainty in terms of cumulative frequencies which translates into age uncertainties $\leq$ 20 % for ages $\leq$ 3 Ga and much less for ages $>$ 3 Ga. 3) Arguments will be given from direct measurements for the Serenitatis and Nectaris basins [8] against the idea of a lunar cataclysm (late heavy bombardment).

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