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The Characteristics of the Impact Crater Production Size-Frequency Distributions on the Solar System Planetary Bodies, their Relationships to Asteroidal and Cometary Impacts, and the Question of Secondary-Cratering Contributions

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For almost four decades, the cratering records of the major solar-system bodies, i.e. of the inner terrestrial planets, of a number of asteroids, and of the satellites of Jupiter and Saturn, have been investigated in detail by various groups. Some of the early concepts, e.g. assumption of simple power laws for the distributions of the kind of $N \sim D^{-\alpha}$ (N cumulative number per unit area, D crater diameter, α of the order -2), or the assumed dominance of secondary craters in the size range D<1km, or the role of comets in the cratering record of the solar system, have been proven at least partially wrong or at least questionable by this group. Nevertheless, there is a tendency in parts of the community to still stick to the old obsolete concepts. Some of these issues have been discussed in the context of investigations of the Mars cratering record and age dating exercises. Some criticism of especially our own work by some US investigators has gone so far as to state that the small-cratering record (D<1km) cannot be used at all for dating planetary surfaces because it is allegedly contaminated by secondary craters from the large primaries which allegedly follow a distribution $N \sim D^{-2}$. We will discuss this issue and show that those arguments are totally wrong. From analysis of the distributions on the surfaces of the moon, Mars, and of some asteroids, we will show that there is nothing like a D^{-2} distribution and that the steep distribution at D<1km is due to primaries. Comparison with the distributions found on asteroids such as Gaspra confirm the steep chraracteristics at D<1km and establish the link to the asteroid belt as the primary source of impactors responsible for the cratering record on bodies of the

inner solar system. A direct comparison with asteroid diameters in the main belt measured through astronomical methods confirm the crater size-frequency distributions in terms of underlying impactor size-frequency distribution at larger sizes.

It will also be shown that there is an outstandingly good internal consistency in making use of small craters for the planetary cratering chronologies and deriving absolute model ages, in particular for the moon and Mars, which could not be the case if the distributions were of the kind D^{-2} at all sizes including sizes <1km, but that the chronologies which have been demonstrated to be utterly consistent with lunar rock isotopic age data would be off by orders of magnitude if our group's interpretations were wrong.