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POSSIBLE DEFICIENCY OF LARGE MARTIAN CRATERS AND RELATIVE CRATERING OF THE TERRESTRIAL PLANETS. *Richard A. Schultz, Geodynamics Branch, NASA Goddard Space Flight Center, Greenbelt, MD 20771.*

The relative size-frequency distribution of impact craters and basins on Mercury, the Moon, and Mars is remarkably similar [1], suggesting that all three bodies were bombarded by the same population of objects early in solar system history [2]. However, Mars appears to be deficient in large craters relative to Mercury and the Moon [3,4]. Part of this difference appears to be observational because large partly buried or eroded craters may not always be included in crater inventories [e.g., 5]. The relative deficiency of large craters on Mars conflicts with the interpretation of a common population of impactors within the early inner solar system [1,2] and suggests either of two possibilities. If the apparent deficiency of martian craters is real then the population of impactors at Mars differed significantly from that closer to the Sun. If the apparent deficiency is not real then the complete crater inventory of Mars should be similar to those of Mercury and the Moon, supporting the interpretation of a single population of impactors. These alternative possibilities can be tested by comparing revised inventories that include partly buried or eroded craters to an estimate of Mars' possible relative crater deficiency.

The number of "deficient" martian craters was estimated by subtracting binned lunar crater counts from the binned martian counts and propagating their uncertainties [6]. All counts were normalized by the surface area of Mars. Comparison of *Barlow's* [5] crater and basin inventory for Mars to the lunar one shows the apparent deficiency [3,4] of large martian craters having diameters ~100 km < D < 1000 km relative to the Moon (Fig. 1a, b). The mercurian curve (not shown) is indistinguishable statistically from the lunar curve [1]. All three bodies contain the same relative number of large basins (D > 1000 km). Lateral shift of the martian curve to the next larger diameter bin in order to compensate for lower relative impact velocity [3] eliminates the deficit for craters less than 250 km ($\log D = 2.4$) in diameter (Fig. 1b). Revision of the multi-ring basin record [4] does not affect the deficit significantly. The difference between the lunar and martian crater counts shows that a considerable number of large martian craters may remain uncounted.

Best-fit polynomials to cumulative size-frequency crater distributions have been used to define 'standard crater curves' [e.g., 7]. These curves are somewhat artificial because they incorporate crater data from geologic units having different counting areas and absolute ages. Nevertheless, they can be useful for interplanetary comparisons and resurfacing studies. The *Neukum and Hiller* 1981 and *Neukum* 1983 fits were determined by using smaller craters (< 20 km in diameter), and the revised 1983 fit increased the order of the best-fit polynomial from 7 to 11. However, neither curve fits martian crater data at diameters larger than 100-300 km. A new "Mars reference curve" was obtained by converting the binned crater data [5,4] into log-log cumulative form and obtaining best-fitting polynomials by using weighted least squares. The martian crater and basin record can be adequately represented by either a single cubic equation (1) or two equations (2) (see Fig. 2):

$$\Sigma N = 3.40 + 3.47\,D - 2.68\,D^2 + 0.42\,D^3 \qquad 8 \le D < 5000 \text{ km} \qquad (1)$$
$$\chi^2 = 16.8$$

or

$$\Sigma N = 4.67 + 0.70\,D - 0.77\,D^2 \qquad 8 \le D < \sim 500 \text{ km} \qquad (2)$$
$$\chi^2 = 21.2$$
$$\Sigma N = 4.96 - 1.21\,D \qquad D > 500 \text{ km}$$
$$\chi^2 = 0.646$$

These best-fit curves are simpler than previous fits that were restricted to small crater data. Equation (1) or something similar would be appropriate if the apparent crater deficiency is observational; additional counts of large craters may reduce the knee near 200 km (Fig. 2a: *log D* = 2.3). Equations (2) would be appropriate if the apparent crater deficiency is real and the associated impactor population thereby different than that for Mercury and the Moon. Equations (1) and (2) are better fits to the data than a simple D^{-2} distribution (Fig. 2c). These results provide a means to test the interpretation of a common source of impactors within the early solar system once more complete crater counts for older martian terrains become available.

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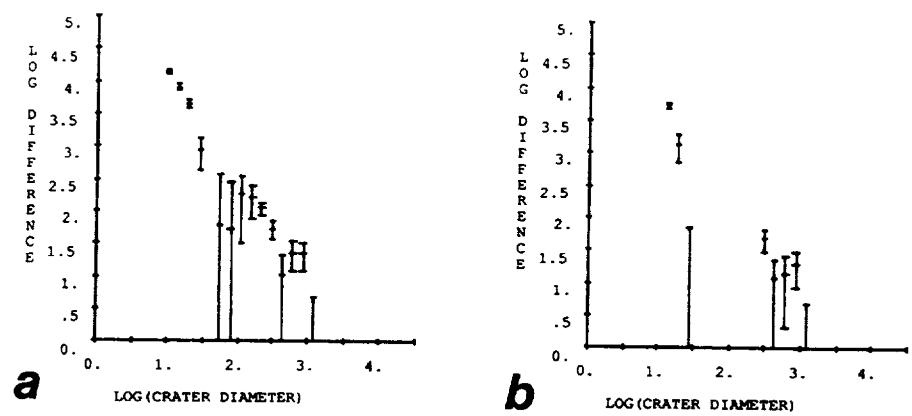

Fig. 1. Plots of difference between number of lunar and martian craters vs. binned crater diameter. All data normalized to surface area of Mars. (a) Direct subtraction. (b) Subtraction after correction for suggested differences in heliocentric impactor velocity.

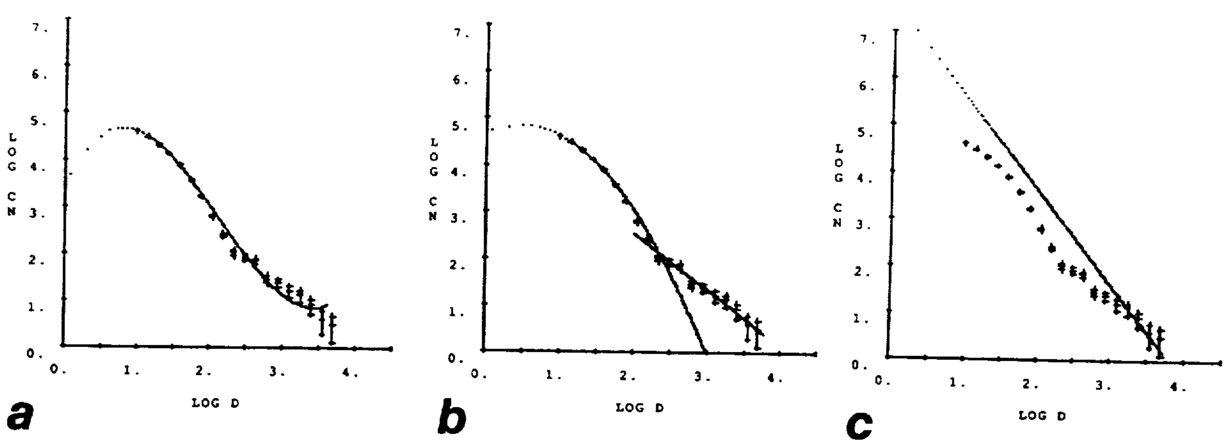

Fig. 2. Cumulative frequency plots of martian craters and basins; data from [5,4]. (a) Cubic best fit, equation (1). (b) Best fit if two impactor populations are defined; equations (2). (c) D^{-2} curve with intercept $a_o = 7.6$.