ON THE BREAKUP DIAMETER OF METEOROIDS IN THE VENUSIAN ATMOSPHERE; B.A. Ivanov: O.Yu. Schmidt Institute of the Earth Physics, USSR Academy of Sciences, Moscow.

The influence of the massive Venusian atmosphere on impact cratering has been proposed in many papers (1, 2, 3, etc.). Ivanov *et al.* (4) compared the observed size-frequency distribution of impact craters on Venus with a simple model of atmospheric breakup of projectiles and concluded that the Venusian atmosphere seems unchanged over the last 0.5–1.0 by. In this paper, the effective breakup diameter of projectiles will be estimated for the present and presumably constant atmospheric parameters.

The main simplification of this paper is the supposition that there is some critical value of the projectile diameter D^*_p : for $D_p > D^*_p$ the projectile decelerates in the atmosphere as a solid body without any damage; for $D_p < D^*_p$ projectiles completely disperse during atmospheric entry without forming craters. Using this approximation, we calculate a series of model size-frequency curves and choose the curve that best fits the observational data. To do this we need five additional approximations:

a.) The value of D^*_p for different angles of incidence varies as $D^*_p = D^*_{pv}/\sin\alpha$, where α is the angle from horizontal and D^*_{pv} is the critical body diameter at vertical incidence (3, 4).

b.) Crater diameter relates to projectile parameters (5) as

$$D = 0.96\ KE^{1/3.288}\ v^{-0.102}\ (\sin\ \alpha)^{.39}$$

where KE is the kinetic energy, Mton TNT, and v is the impact velocity, km/s.

c.) The distribution of impact angles supposed to be the same as in the case of a random distribution of projectiles far from the planet: $\sin 2\alpha \cdot d\alpha$ (6).

d.) The distribution of projectile velocities is the same as on the Earth as estimated from the catalog of McCrosky (7). Comparison with Shoemaker's data (8) shows good agreement.

e.) The size-frequency of craters on an atmosphere-free Venus was assumed to be the same as on the Moon: $N \sim D^{-1.8}$, where N is the number of craters per unit area in the $\sqrt{2}$ increments of diameters (9).

The results of calculations are illustrated in Figure 1. Curve 2 provides the best fit for the projectiles of 3g/cm³ density and corresponds to a breakup diameter D^*_{pv} of 0.9 km. The curve gives a rather good approximation to the data at the observed maximum point and for larger craters. Underestimates for smaller craters may be related to impacts by projectile fragments, a process which was not included in the model.

The same procedure was made for different values of projectile density, but Figure 1 is used to emphasize another result. If the critical diameter varies as

$$D^*_{p1} / D^*_{p2} = \sqrt{\rho_2 / \rho_1}$$

(3, 4) for a projectile density, ρ, then curves 1 and 3 in Figure 1 correspond to ice and iron projectiles. Thus the method used in this paper cannot provide evidence for different projectile types unless the effect of strength is included. Results of simple numerical calculations of the deformation of a fluid body passing the Venusian atmosphere (10) may be approximated with the present model with D^*_{pv} = 2.5 km. The corresponding size-frequency model (Curve 4) is too low in comparison with the best fitting curve. Thus one may conclude that projectiles producing venusian craters in the diameter range from 8 to ~50 km possessed some strength. Such an approach can give some estimate of the strength of celestial bodies if more realistic models of breakup could be simulated or modeled.

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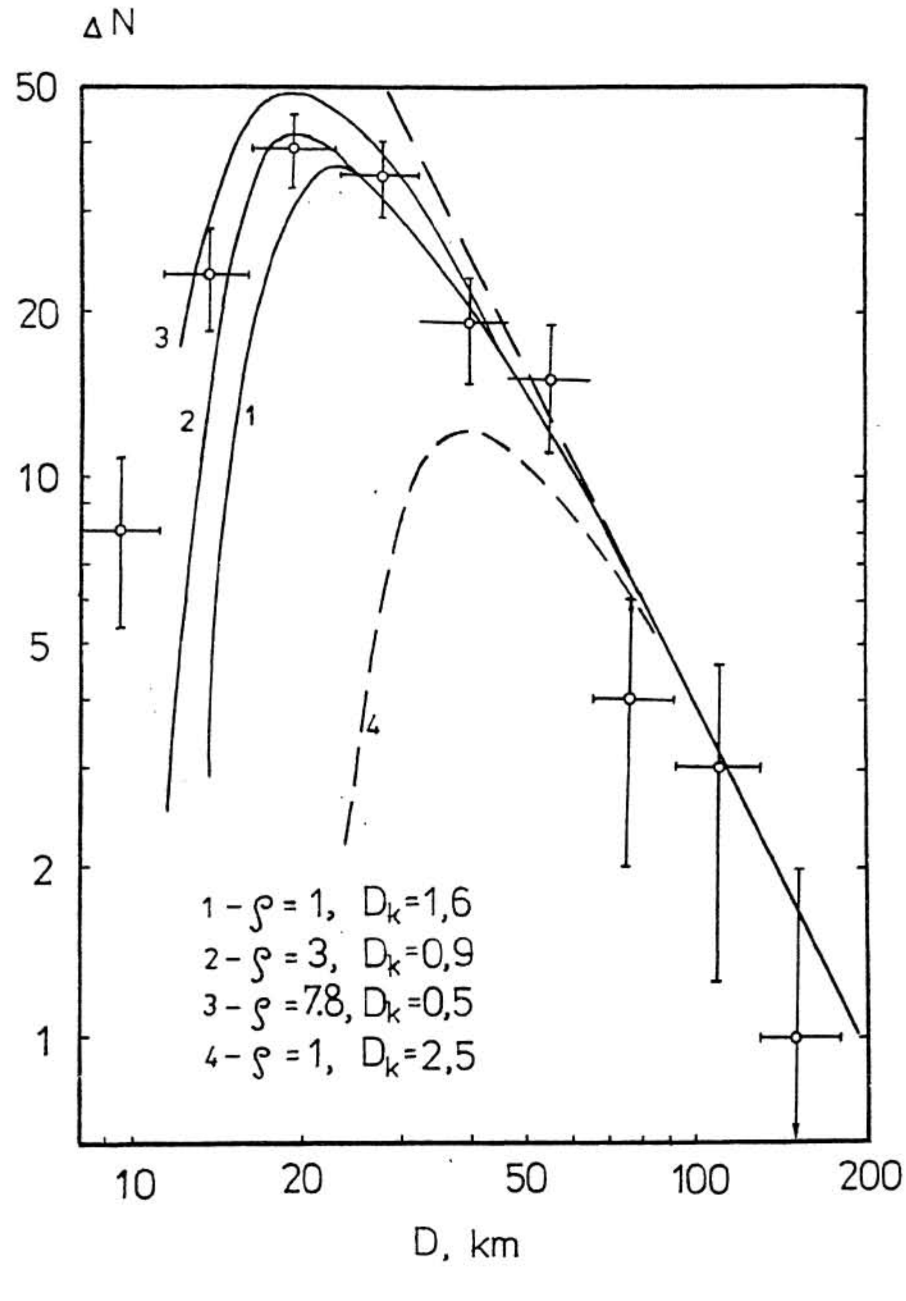
Figure 1. The calculated effect of meteoroid break-up on the incremental size-frequency distribution of craters on Venus. Circles with crosses correspond to data for Venus with curve 2 providing the best fit for projectiles 3 gm/cm³. Curves 1 and 2 correspond to ice and rim projectiles, respectively. Curve 4 incorporates the effect of projectile strength and departs significantly from the observed data, thereby indicating that Venusian impactors must possess some inherent strength.



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