AIRBURST ORIGIN OF DARK SHADOWS ON VENUS, K. J. Zahnle, NASA Ames Research Center, MS 245-3, Moffett Field CA 94035

A simple analytic model for the catastrophic disruption of impactors in the atmosphere is used to (i) reproduce observed venusian cratering statistics and (ii) generate radar-dark disks by the impact of atmospheric shock waves with the surface. When used as input to Monte Carlo simulations of venusian cratering, the model nicely reproduces the observed low diameter cut-off. Venusian craters are found to be more consistent with an asteroidal rather than a cometary source. Radar-dark "shadows" on the surface, usually circular, appear as the signature of airbursting impactors. A typical craterless airburst is the equivalent of a $10^5$-10$^6$ megaton explosion. The airburst is treated as a massive, extended explosion using a thin-shell, isobaric cavity approximation. The atmospheric shock waves excited by the airburst are then coupled to surface rock using the usual impedance matching conditions. Peak shock pressures experienced by surface rock typically exceed 0.2 GPa for distances 15-30 km from ground zero, and 1 GPa for 10-20 km. These high shock pressures are felt to considerable depth, often more than a kilometer. Presuming that such shocks would reduce surface rocks to a fine rubble, airbursting impactors could account for the origin of the dark shadows on Venus.

Figure 1. The cumulative number of craters bigger than a given diameter observed on Venus and compared to Monte Carlo simulations with surface exposure ages of 0.5 and 1.0 billion years.