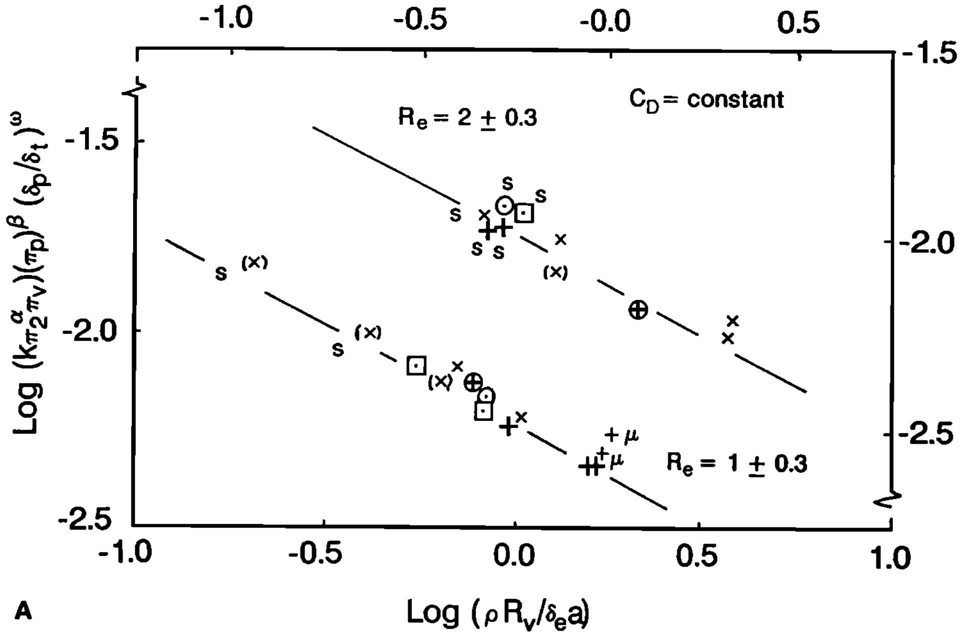
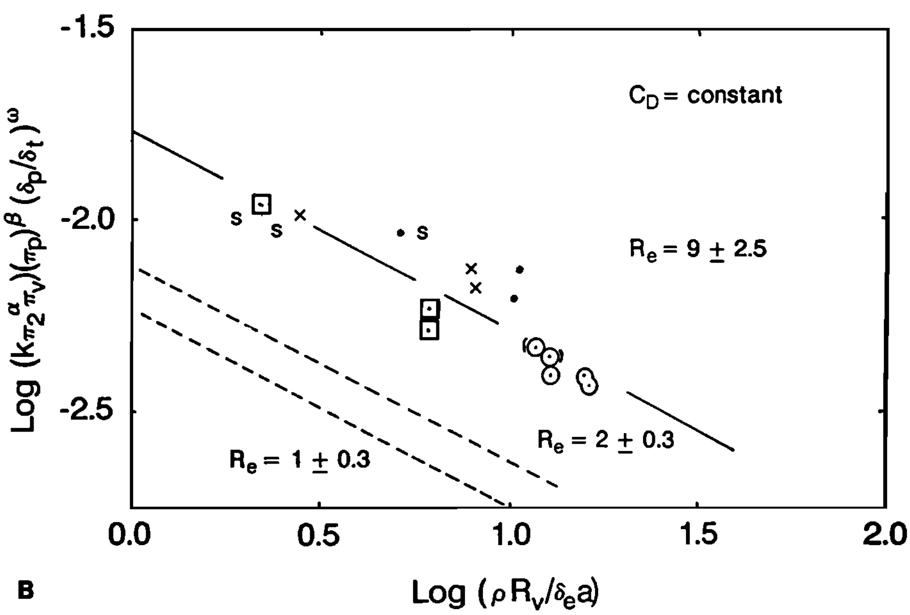


A



B

Fig. 9. Cratering efficiency corrected for the dimensionless pressure term π_p (defined as $(P/\delta_t v^2)\ \pi_2^{\alpha/3}$) as a function of aerodynamic deceleration over a limited range of Reynolds numbers *Re* thereby keeping the drag coefficient approximately constant. Because different projectile and targets are used, a density ratio term (δ_p/δ_t) is now explicitly included following *Holsapple and Schmidt* [1987] with an exponent given by $\omega = (\mu/2 + \mu) = 0.17$ for a value of $\mu = 0.41$ characterizing the pumice target. The Reynolds number is based on interactions between individual ejecta particles and the atmosphere. The complete dimensionless drag parameter is given by equation (14) but is shown here without the values of the drag coefficient and gravity, which are simply constants. (As shown, atmospheric density is referenced to air while particle size and density are referenced to pumice; R_v is in cm.) Figure 9*a* shows two different values of Reynolds numbers, thereby leading to an expected offset reflecting different values of the drag coefficient (note corresponding offset in axes, top and bottom). Data in parentheses indicate projectiles with diameters other than 0.635 cm, whereas data labeled with "*s*" and "μ" indicate sand and microsphere targets, respectively. The resulting scatter for a given *Re* is small. Figure 9*b* shows data with a much larger value of *Re* and reveals a significant increase in scatter at least partly related to gas composition (viscosity or Mach number) and high velocity (pressure-corrected gravity-scaled cratering efficiency is shown in dimensionless form).

1 displaces nearly twice as much target material as a similar velocity impact in helium ($M \sim 6$). Atmospheric composition significantly increases scatter in the data at higher Reynolds numbers (Re ~ 10) with air/nitrogen data systematically higher than carbon dioxide.

Figures 8 and 9 indicate that aerodynamic drag affects cratering efficiency and that the power law dependence not only can be derived empirically but also can be understood by modifying the gravity-scaled π_2 parameter given by *Schmidt and Holsapple* [1980, 1987] for vacuum conditions. Inclusion