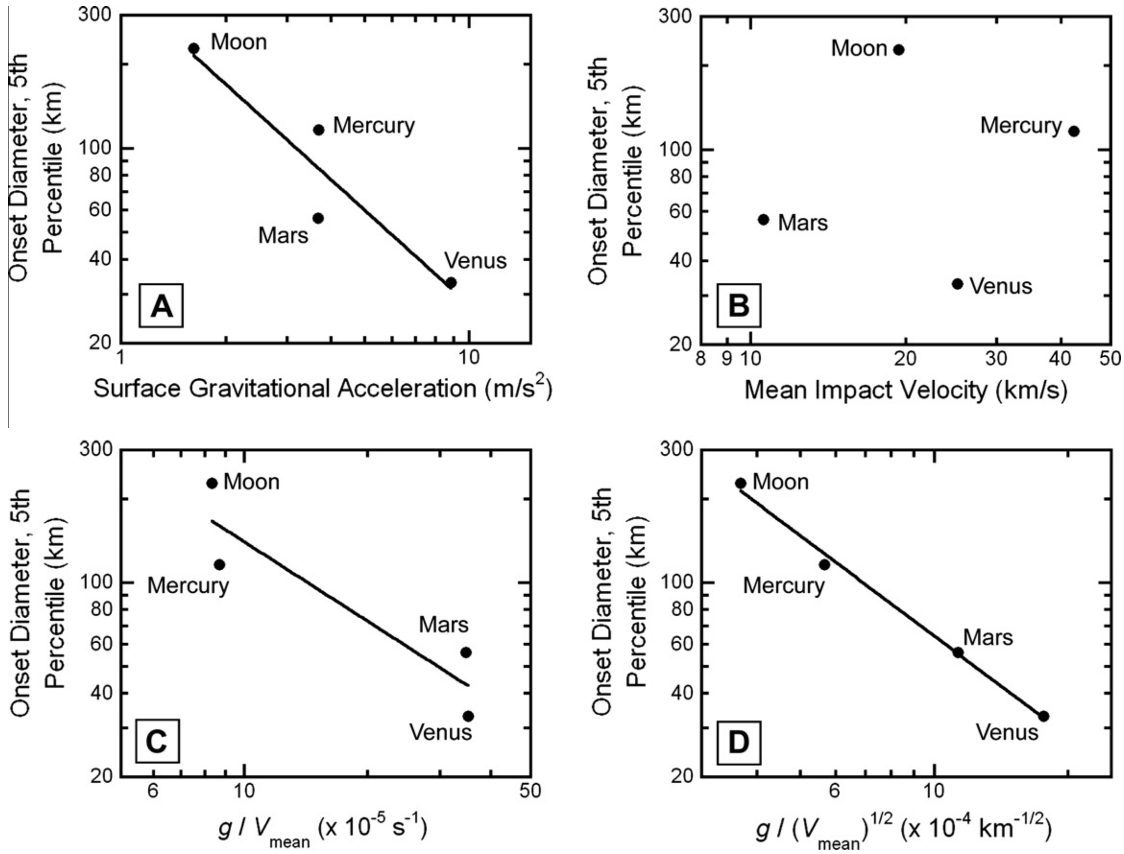

Fig. 6. Plots of the 5th percentile onset diameters for peak-ring basins on the Moon, Mercury, Mars, and Venus (Table 1, "onset diameter, method 2") versus surface gravitational acceleration (g) (A), mean impact velocity (V_{mean}) (B), the ratio of g/V_{mean} (C), and the ratio of $g/\sqrt{V_{\mathrm{mean}}}$ (D) (Table 1). Solid lines are power law fits formed by minimizing the sum of the squared errors in the ordinate. The fits are displayed to emphasize general trends in the data and are not meant to be statistically rigorous representations. We did not include a fit for mean impact velocity due to lack of a clear trend. A correlation between onset diameter and gravity (A) is the strongest, with little correlation existing with mean impact velocity alone (B). The correlations of onset diameter with a combination of gravity and mean impact velocity (C and D) are more comparable or stronger than with gravity alone, suggesting that both gravity and mean impact velocity are important in influencing the onset of peak-ring basins.

We plot our onset diameters (5th percentiles, Table 1) for peak-ring basins as a function of the planet's surface gravitational acceleration (g) and the planet's mean impact velocity (V_{mean}) in log–log space (Fig. 6). The mean impact velocities are taken from recent modeling of the distribution of planetary impactors (Le Feuvre and Wieczorek, 2008). We also include power-law fits to the data by minimizing the sum of the squared errors in the ordinate. Given the uncertainties in the plotted data (especially for Mars and Venus) these fits are not meant to be statistically rigorous representations and should only be viewed as illustrating the general trends in the plotted data, As in previous studies, the strongest correlation with peak-ring basin onset diameter is the planet's gravitational acceleration (Fig. 6A). No correlation is observed between onset diameter and velocity alone (Fig. 6B), although a stronger correlation is observed when the mean impact velocity is combined with gravity (i.e., g/V_{mean}) (Fig. 6C). Although it may have no physical significance, there is a very strong correlation (in log–log space) between onset diameter and gravitational acceleration over the square root of the velocity ($g\sqrt{V_{\mathrm{mean}}}$) (Fig. 6D). To first-order, these comparisons suggest that gravity is likely to be important in the process of forming peak rings. While there is no correlation between peak-ring basin onset diameter and impact velocity alone, a fairly strong correlation is found when impact velocity is combined with gravity. Like gravity, this correlation is not perfect, and the details of its physical meaning are not certain without a more detailed examination of the parameter space of impact events. Based on these observations, we suggest that both gravity and velocity are likely to be important in the formation of peak rings.

6.4. Surface density of peak-ring basins

The Moon has about a factor of two fewer peak-ring basins per unit area (4.5×10^{-7} per km^2) than Mercury (9.9×10^{-7} per km^2, Baker et al., 2011) and a factor of two to five greater number of peak-ring basins per unit area than Mars or Venus (Table 1). While the crater size distributions for impact craters between 100 km and 500 km in diameter are nearly the same on the Moon and Mercury (e.g., Strom et al., 2005) the mean and onset diameters for peak-ring basins on the Moon are much higher than on Mercury. The lower onset diameter for peak-ring basins on Mercury (Table 1) may account for the factor of two larger number of peak-ring basins per area on Mercury than on the Moon. The large number of peak-ring basins on Mercury has also been attributed to the high mean impact velocities of its impactors and increased impact melt production (Head, 2010; Baker et al., 2011). This could facilitate the onset of peak-ring basins at smaller impactor sizes, which are more numerous than larger-sized impactors. The surface density of craters between 100 km and 500 km in diameter is much lower on Mars than on Mercury and the Moon due to extensive erosion and resurfacing (Strom et al., 2005), which could partially explain the relatively small number of peak-ring basins on Mars. Venus has also undergone much resurfacing, which certainly has affected the number of peak-ring basins preserved on its surface.