IMPLICATIONS OF THE DEEPEST FRESHEST LUNAR CRATERS. Joseph M. Boyce, Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, Hawaii, 96822, jboyce@higp.hawaii.edu.

Lunar Topographic Orthophoto maps (LTO) at 1:250 k scale have been used as a basis to measure the depth (d_r and d_s), diameter (D), and rim height (H_r) for 359 fresh Lunar craters in the diameter range of .08 – 131 km along the Apollo metric camera ground tracks. This study used LTO maps with high enough sun angle photography to permit deep crater depth measurements. This includes an area of ~ 3.5 x 10^5 km^2 (1.1 x 10^5 km^2 maria and 2.4 x 10^5 km^2 uplands). Figure 1 is a plot of d_r/D values of fresh lunar craters measured in this study. Similar data were collected in the pioneering work of Pike [1] and are shown in the background of this figure for comparison purpose. The numerical data in this study [1] were not published, and as a result can not be used for some types of studies [e.g., see 2, 3, and 4]. The data produced in this study will be available on-line at the USGS, Astrogeologic Studies Crater Consortium website.

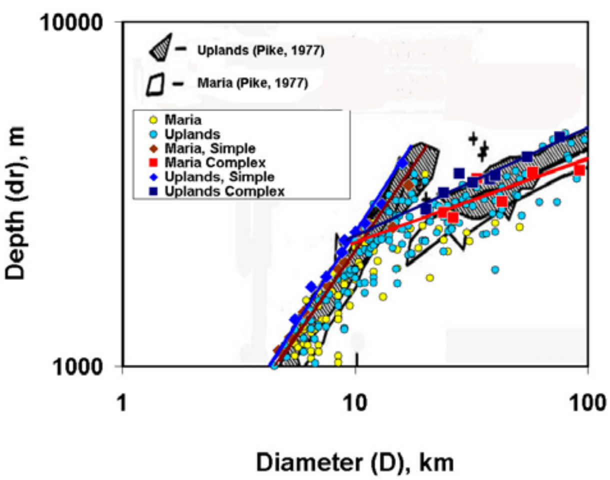

Figure 1. *Scatter diagram showing d_r/D values of deep, fresh lunar craters. The deepest uplands craters are in blues, while the deepest maria craters are in reds (diamonds = simple, squares = complex). The best-fit curves are included for the deepest, fresh craters of each type. The lunar data of Pike [1] are also included and show the agreement between data set.*

Using the approach of [4], the d_r/D function for the deepest, freshest Lunar craters (i.e., an approximation of the final, post-formation d_r/D function) has been calculated for simple and complex craters for both maria and uplands regions (see Figure 1). Excluded in this calculation was the diameter range (10.5 – 20 km); the diameter range where simple and complex craters of the same size occur together, thus confusing the calculations [2, 3, 4, and 5]. The functions for simple maria and uplands craters are nearly the same, while those for complex maria and uplands craters show greater difference.

Simple maria: $d_r=218\ D^{1.03}$, $R^2=0.998$)
Simple uplands $d_r=195\ D^{1.12}$, $R^2=0.999$)

Complex maria: $d_r=1311\ D^{0.24}$, $R^2=0.78$)
Complex uplands: $d_r=1141\ D^{0.32}$, $R^2=0.95$)

This difference may be due to statistical error generated because the maria sample region contains less than half the area sampled in the uplands. Even so, the simple/complex transition calculated for both maria and uplands is ~ 10.3 km diameter. This is significantly different from that calculated by [1], and may be a result of inclusion of the transition zone craters in those calculations.

Figure 2 is the map distribution of the fresh craters in this study. Using the approach of [2,

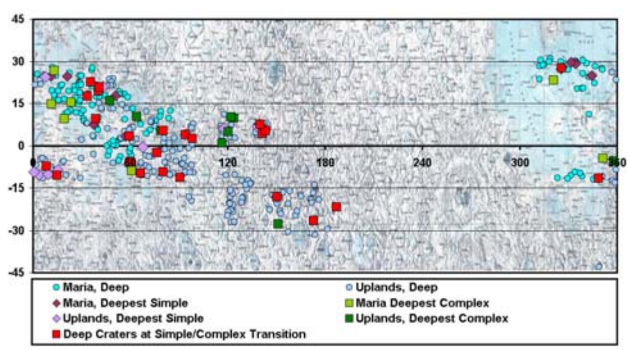

Figure 2. *Map of the distribution of deep craters measured in available 1:250 K scale LTO maps. Note that, unlike Mars, the deepest craters in the simple/complex transition range (red squares) do not cluster.*

3, 4], we include the deepest craters in each diameter bin, and the craters in the simple/complex transition range > 10% deeper than predicted for complex crater of their size. This map shows that, unlike on Mars, such craters do not cluster as would be expected if areas of significantly different target physical properties occur in the area sampled.

We have attempted to estimate the final, post-formation d_r/D function for craters (i.e. fresh crater curves) on each of the terrestrial planets using the approach of [3]. In this study, we extend this approach to the published d_r and D data for the terrestrial planets [1, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14] as well as the new lunar d_r/D data discussed here to calculate the simple and complex craters transitions (D^*) for each terrestrial planet (Table 1).

Planet	Gravity g, cm/sec	D* Simple/Complex , km
Moon, Maria	162	10.3
Moon, Uplands	162	10.3
Mercury	350	7.75
Mars	370	7
Venus	890	3.5
Earth Average	981	3.1
Earth, Crystalline Rock	981	4.5
Earth, Sedimentary Rock	981	2.25

Table 1. *List of the acceleration of gravity at the surface of the terrestrial planets, and the simple/complex crater transition diameters for those planets*.

These data are plotted against the acceleration of gravity (g) for each of the respective planets and shown in Figure 3. Similar to the relation first found by [11] our data show an inverse relationship between the transition diameter and gravity, but instead is described by $D^* = 0.299\ g^{-0.66}$ ($r^2 = 0.99$) indicating that gravity dominated behavior occurs at smaller crater sizes on the terrestrial planets. This observation has implication to models of crater collapse during the modification phase of crater formation.

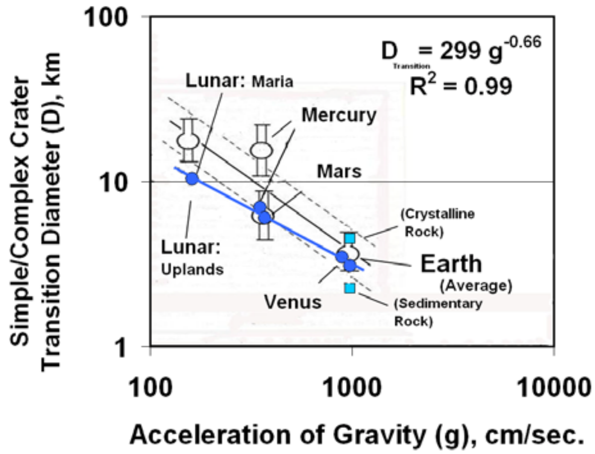

Figure 3. *Plots of the simple/complex crater transition for each of the terrestrial planets* verses the acceleration of the gravity of those bodies. Data symbols in black are from [10], *and data in blue are from this study using the new method for calculation of the simple/complex transition*

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