CRATER MORPHOMETRY ON VENUS: MORPHOMETRIC TRENDS IN THE YOUNGEST BRIGHT-FLOORED CRATERS. R.W. Wichman, Dept. of Space Studies, Univ. of North Dakota, Grand Forks, ND 58202.

Summary: As part of a broader study of crater modification on Venus, measurements of crater rim, crater floor and central peak diameters have recently been made for 42 venusian craters with parabolic ejecta features. These measurements have yielded well defined linear relations for the relative size of floor and central peak units in pristine venusian impact craters, and will be used to assess the variation of floor and central peak sizes in more modified impact structures. In addition, however, the derived relations for both floor size and central peak size (relative to crater diameter) show strong differences from the morphometric trends observed in lunar craters. Since the trend of central peak to floor sizes parallels the observed lunar trend, these data support previous predictions that venusian craters are smaller in rim diameter than comparable cratering events on other planets and may provide a basis for testing the relative effects of gravity and atmospheric pressure on venusian crater growth.

Introduction: To analyze the possible importance of crater-centered volcanism for crater modification on Venus, I have begun an analysis of how relative crater floor sizes vary for different classes of venusian impact craters. A preliminary survey of venusian crater morphometry [1] indicates that some variations in floor size may result from crater modification, but it also indicates that both a broader data set and more precise morphometric measurements are needed to fully test these observations. Consequently, I have initiated a second set of more detailed morphometric measurements for specific classes of crater modification, starting with the youngest, most pristine impact craters recognized on Venus. This abstract reports the preliminary results of these measurements.

The Data: The measurements reported here are intended to characterize the morphometry of pristine venusian impact craters for future comparison to similar measurements in other, endogenically modified venusian impact craters. Consequently, since the youngest craters on Venus appear to be associated with peripheral dark-halos or parabolic ejecta deposits [2], I have made measurements on 42 such craters over 15 km in diameter explicitly identified by [3]. Each crater was analyzed using a full resolution F or C1-MIDR, and the reported feature diameters are all derived from a traced outline of that feature. The rim crest and floor diameters are averages of the axis dimensions for a computer-generated, best-fit ellipse to each trace, whereas the given central peak size represents the maximum dimension of such an ellipse. For these calculations, the rim crest is defined as the outermost extent of visible terracing and other wall structures, the crater floor is primarily defined by the contrast in texture at the base of the crater wall, and the central peak diameter reflects the outer edge of identifiable peak ring massifs in the largest craters.

The Results: The derived measurements show a narrow, well-defined trend between floor diameter and rim crest diameter ($D_{fl} \approx 0.83^* D_{rim} - 6.79$; Figure 1) and a somewhat broader trend of central peak diameter to rim crest diameter ($D_{cpk} \approx 0.39^* D_{rim} - 3.05$; Figure 2). These derived trends are similar to those indicated by my preliminary data set (Figure 3), but are less widely scattered. Thus, further measurements may well identify trends that are obscure or poorly resolved in that preliminary survey. There is also a suggestion that the present data are offset to slightly lower floor/rim diameter ratios, but I believe that this offset is an artifact reflecting different definitions of rim crest diameter in the respective data sets. In the nine craters contained by both this data set and my preliminary measurements, the present measurements indicate rim diameters 1 to 8 km larger than those estimates in the preliminary data set, and floor diameters which are slightly smaller (-0.6 km on average) than the earlier estimates. Indeed, since the crater rim diameters presented here are also systematically larger (~2 km on average) than those published by [4] for any given crater, these values apparently represent maximum estimates for their respective crater sizes.

Discussion: In addition to providing a basis for analyzing crater floor modification on Venus, the morphometric relations derived here also may provide constraints for modeling the impact process on Venus. Specifically, it is well known that both crater floor and central peak sizes on the Moon vary with crater size [5, 6]. The observed trends on Venus, however, appear to be significantly different from those observed on the Moon (Figures 1, 2). The venusian craters typically contain both larger floor and central peak units than is indicated for lunar craters of comparable size, and the rate of change with crater size in these values is also greater. On the other hand, the derived central peak sizes relative to floor size show nearly the same trend as that which is observed on the Moon (Figure 4). This similarity is most apparent for craters smaller than ~30-35 km in diameter, however, while the transition from central peak to peak ring craters apparently occurs at diameters of ~30-40 km [7]. Thus, figure 4 may also indicate a minor change in the morphometry of central peak and peak ring craters on Venus.

Although the relation of floor size to crater growth is poorly known [5], these observations are consistent with a decrease in venusian crater rim sizes relative to the interior crater structures. Since both gravity and the high atmospheric pressure on Venus should tend to choke off crater growth at an earlier time than on the Moon [8], such a reduction in crater diameter has been independently predicted and documented [8]. The similarity of central peak to floor ratios on the Moon and Venus is unexpected, however, and therefore may provide a basis for beginning to assess the relation of these features to crater formation. In addition, a comparison of the derived morphometric trends to theoretical predictions for the effects of gravity and atmospheric pressure on crater growth also may provide a basis for partially separating the importance of these different factors in restricting crater growth.

REFERENCES: [1] Wichman, R.W. (1995) *Lunar Planet. Sci. Conf. 26*, this volume. [2] Arvidson, R.E. et al. (1992) *J. Geophys. Res. 97*, 13303-13317. [3] Campbell, D.B. et al. (1992) *J. Geophys. Res. 97*, 16249-16278. [4] Schaber, G.G. et al. (1992) *J. Geophys. Res. 97*, 13257-13301. [5] Pike, R.J. (1980) *Geometric Interpretation of Lunar Craters* U.S.G.S. Prof. Paper 1046C. [6] Hale, W. and Head, J.W. (1979) *Proc. Lunar Planet. Sci. Conf. 10*, 2623-2633. [7] Alexopoulos, J.S. and McKinnon, W.B. (1994) in *Geol. Soc. Amer. Sp. Paper 293*, 29-50 [8] Schultz, P.H. (1992) *J. Geophys. Res. 97*, 16183-16248.

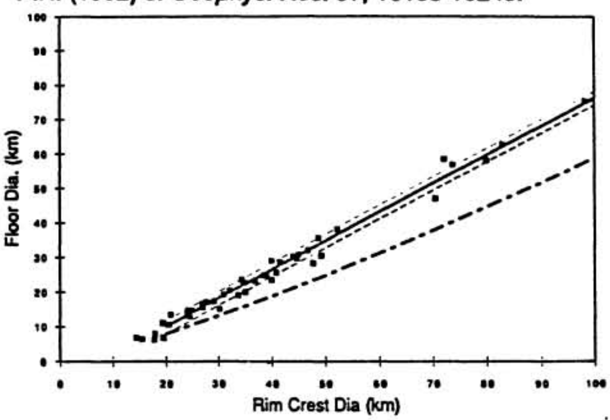

Figure 1. Relation between floor size and crater diameter, showing data values and the derived least square approximation. Light dashed line indicates 1σ error (±1.99) around regression line, while heavy dashed line shows derived relation for lunar craters of [5].

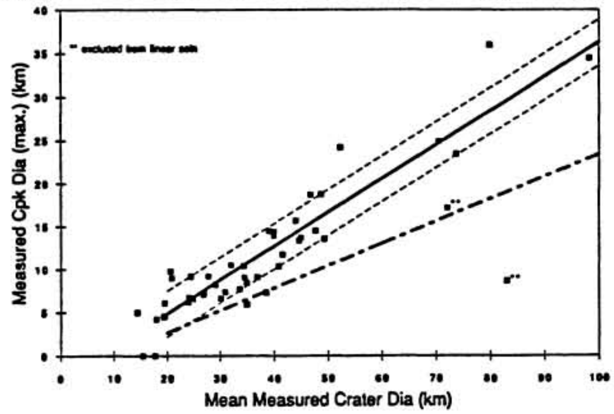

Figure 2. Relation between central peak size and crater diameter, again showing data values and least squares approximation. 1σ error in this case is ±2.65, and heavy dashed line shows derived morphometric relation for lunar craters of [6]. The 2 craters excluded from the linear solution (Stowe, Boleyn) preserve partial peak rings which probably do not represent full size of the central crater uplift.

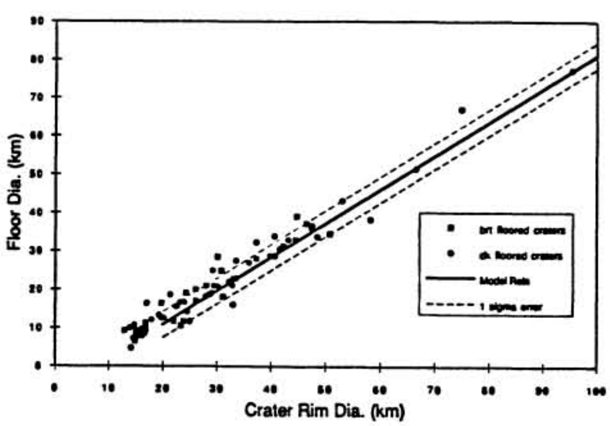

Figure 3. Comparison of derived floor-rim size relation (lines) to preliminary morphometric data set of [1].

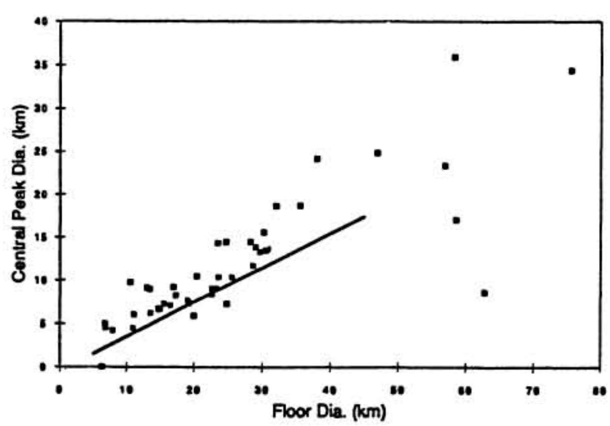

Figure 4. Relation between floor and central peak sizes in parabolic ejecta craters, with solid line showing derived relation for lunar craters [6].