The hypothesis that Venus was mostly resurfaced in a catastrophic volcanic event ~500-750 Mya [1, 2] relies on the observation that only of dark floor deposits may record impacts. Dark floor craters may record more continuous volcanic resurfacing if they are indeed resurfaced by lava flows [1, 3]. Here we measure the volume of dark floor deposits for a subset of Venus craters to test whether can be explained by impact melt retained within the crater, or if they suggest infilling by volcanic flows [4].

**Morphometric calculations**

Crater morphometries are determined from the following sources:

**Area measurement:** See Fig. 1.

**Radial depth measurements:** See Fig. 2. Crater rim depths (d) and central peak heights (Hc) are obtained through this method.

**Empirical power-law functions:** Using equations describing relationships observed by [6] and [7], we can utilize power-law functions for parabolic crater depth to estimate dark floor thickness (t), in addition to functions describing crater wall width (Ww) and central peak diameter (Dcp).

\[
 d = 0.4D^{1.4}
\]

**Equation 1:** Power-law function describing crater depth, derived from measurements of 22 bright-floored craters with parabolae. From [8].

\[
 t = d - d_c
\]

**Equation 2:** Dark floor thickness, produced by subtracting the crater rim depth d from the "fresh" crater depth d.

\[
 V = \pi t^2 d
\]

**Equation 3:** Dark floor volume before applying wall and central peak corrections, the product of the average dark floor area, \(a\) and the dark floor thickness, \(t\).

**Crater geometry corrections:** We apply the functions described above to correct for the cross-sectional contribution of crater walls and central peaks, utilizing Ww, Dcp, and Hc to obtain wall slope and central peak slope values b and α (Fig. 3).

**Can impact melt account for the volume of dark-floored craters?**

Croft [8] produced empirical functions relating transient crater diameter to the simple-to-complex transition diameter and rim diameter, based on terrestrial and lunar measurements (Fig. 4).

\[
 D_c = D_{r \text{trans}}(4.15+D_{\text{trans}})^{0.122}
\]

**Equation 4:** Crater transient diameter \(D_c\), where \(D_{\text{trans}}\) is the simple-to-complex transition diameter, taken to be 3.5 km for Venus. \(D_r\) is the measured diameter of the crater. From [8], see Fig. 4.

**Crater outflows**

Impact melt is often observed outside of craters, where it is visible as highly radiant, lobate flows. We note craters that have observable outflows, interpreting them as examples of impact melt exterior to the crater. Dark floor volumes calculated for these craters represent a minimal contribution of impact melt.

For craters with observable central peaks, we note that 16 craters have visible outflows, while 10 craters do not have observable outflows. For craters with no observable central peak, we note that 6 craters have visible outflows, while 10 craters do not have observable outflows.

**Impacts of volcanic resurfacing?**

The other 34 dark floor craters represent some resurfacing or inter-crater volcanism. The other 34 dark floor craters represent ambiguous cases where the crater may have experienced some resurfacing or inter-crater volcanism, though further work is needed to constrain impact melt volumes from observed areas (Fig. 6).

In addition to impact melt outflow measurements being beyond the scope of this study, our work assumes that for dark floor volumes that fall under an impact melt volume regression, at least some impact melt contributes to the dark floor volume. While it is again beyond the scope of this study to quantitatively scale the likely contribution of impact melt to the dark floor volume, we speculate that it is more likely for dark floor deposit volumes below the lower impact melt volume regression to have a greater contribution of melt volume than for dark floor deposits that lie just underneath the minimum impact melt volume regression, for example.

**As only 2 craters have mean dark floor deposit volumes that exceed maximum calculated impact melt volumes, we argue that resurfacing is minimal-to-modest in our population of 42 craters.**

**References:**


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