**Introduction:** Transient and disruption cavity sizes are fundamental parameters in the study of impact structures [1]. They are governed by the velocity, size and density of the impacting body, the target density and ambient gravitational acceleration. Hence, knowledge of transient and disruption cavity dimensions allows the calculation of energy release associated with impact. Since the recognition of the devastating environmental effects related to the Chicxulub crater it has been underscored that accurate estimates of transient and disruption cavity dimensions are crucial in evaluating potential environmental degradation from an impact.

**Cavity dimensions:** For simple craters, the transient and disruption cavities are closely related to the final crater shape, both being well-described by paraboloids of revolution. The transient cavity is the melt- and breccia-lined cavity that collapses to form the final observed simple crater form. The final observed crater diameter in a simple crater corresponds to that of the disruption cavity; the limit of disruption of the impacted rocks by brecciation. The transient cavity diameter \( D_t = 0.84D_a \) [2], where \( D \) is the final crater diameter (and equals disruption cavity diameter \( D_d \)).

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Direct observation of \( D_m \) and \( D_s \) through surface geologic mapping is hampered by the varying levels of erosion at terrestrial impact structures. At well-preserved craters, slump faults and melt/suevite units are obscured by impact ejecta and breccia. As erosion levels deepen, these features are revealed but are often modified by later erosion and subsequent reburial resulting in limited exposure. Once erosion has reached down through the CDC floor, little evidence of these elements remain. Consequently, estimates of transient cavity size based on geologic evidence are limited [3,4]. Geophysical data can provide useful estimates of both \( D_m \) and \( D_s \) even when structures are partially or wholly buried. Geophysical methods also have the advantage of being able to achieve systematic areal coverage of a given structure, thus avoiding the problems of limited exposure. By far the most useful are magnetic data, since both \( D_m \) and \( D_s \) are often associated with observable changes in magnetic anomaly character.

The dominant magnetic signature associated with impact structures is a magnetic low or subdued zone, which is commonly manifest as a truncation of the regional magnetic fabric. At larger structures, the magnetic low can be modified by the presence of shorter wavelength, large amplitude, localized anomalies, which
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usually occur at or near the center of the structure. These anomalies are often caused by increased magnetizations (usually thermoremanent) in impact melt rocks and/or suevite deposits [5,6]. They may also be caused by uplifted magnetic lithologies (usually crystalline basement rocks) within the central uplift. In the former case, mapping the outer extent of the melt sheet gives an estimate of its diameter, \( D_M \), while for the latter, the outer extent of the anomalous area gives an estimate of the central uplift diameter, \( D_{CU} \). Within the disruption cavity, we expect to see complete removal or moderate suppression of the regional magnetic fabric. Within the slump zone, the pre-impact magnetic fabric is only slightly modified, since the slump blocks are relatively undeformed and are unshocked. Downward movement of blocks may lead to diminished and broadened anomalies but trends can be preserved and mapped. Therefore determining the innermost occurrence of regional (pre-impact) magnetic trends provides an estimate of the inner limit of \( D_s \).

Estimates of either \( D_{CU} \), \( D_M \) or \( D_S \) from magnetic data at 19 terrestrial complex impact structures are shown in Figure 1. The magnetization levels of igneous and metamorphic rocks are generally much greater than those of sedimentary lithologies, hence magnetic anomalies associated with the latter may not be significant enough to detect the morphological elements discussed above. Consequently, most of the structures used here occur in crystalline target rocks. Values of crater diameter are largely from [7]. The dashed line shows our estimate of the best description of the data which gives \( D_{CDC} = 0.49D \) or \( D_c = 0.41D \). Our \( D_{CDC} \) relation is similar to the 0.5-0.65 \( D \) of [4] based on limited terrestrial data, but is at odds with the scaling relation of \( D_{TC} = D_q^{0.15}D^{0.85} \) of [3] based mostly on lunar craters (\( D_q \) is the simple to complex transition diameter). The observation of cover rocks preserved in the annular trough at 0.5-0.6 \( D \) at Manicouagan [4] is one example of a tighter bound on CDC diameter than the values of \( D_S \) (on average -0.85 \( D \)) determined by [3] based on remote lunar observations. Some scatter about the scaling relation of [3] is expected because \( D_q \) is target dependent so that target lithologies will have some influence. Nonetheless, observations at other terrestrial impact structures [4] clearly deviate from the relationship of [3]. The geophysical evidence from the magnetic data (Figure 1) is more in accord with morphometric relationships [4] derived from geologic mapping.


Figure 1 Plot of scaled estimated bounds on collapsed disruption cavity diameter versus scaled crater diameter (as used in [3]). Filled triangles (▲) = diameter of melt (\( D_M \)). Outlined triangles (●) = diameter of central uplift (\( D_{CU} \)). Inverted triangles (▼) = diameter of innermost slump block (\( D_s \)). Solid line = relation from [3] \( D_{TC} = D_q^{0.15}D^{0.85} \). Dashed line = best fit to data from this study. \( D_f \) = diameter of feature (\( D_{CU} \), \( D_M \) or \( D_s \)). \( D_q \) = simple/complex transition diameter; \( D \) = crater diameter.