CENTRAL STRUCTURES IN MARTIAN IMPACT CRATERS: MORPHOLOGY, MORPHOMETRY AND IMPLICATIONS FOR SUBSTRATE VOLATILE DISTRIBUTIONS. W. S. Hale, Amoco Production Company, New Orleans, LA 70150

Central uplift structures are prominent morphologic features in fresh impact craters, and sample materials from stratigraphic positions well below the target surface and thus not otherwise accessible for study (1). On Mars, central structures in fresh, complex craters are classified as one of three types: (1) central peaks morphologically similar to those seen in lunar and mercurian craters; (2) central peaks with summit pits (pitted peaks); (3) pits in the crater floor (floor pits) where central peaks are absent (2-4). Pit formation may reflect the interaction of crater-forming processes with a volatile component in the substrate (3). Central structures in martian craters can thus act as a sampling tool to determine the distribution of such a volatile component at depth within the substrate (3), although early attempts to determine pit distributions led to conflicting results (3,4). The purpose of this study is to morphologically and morphometrically characterize the central structures in all fresh martian craters for regions covered by the U.S.G.S. Photomosaic Map series, and to determine variations in type with latitude, substrate (terrain), ejecta type (5), and crater rim diameter (Drc). Data was collected for 3018 fresh craters, Drc > 8km, for areas totalling 75% of the surface of Mars including all terrain types (6) and most latitudes (+90° to -65°).

Morphometry - Central structures occur in 2113 craters, 70% of the data set. Central peak (Dcp) and/or pit (Dp) diameter and Drc were recorded for each crater. Statistical analyses define power-law relationships for Dcp/Drc (Fig. 1) and Dp/Drc (Fig. 2). At a given crater diameter, central peaks in martian craters are larger than those in lunar and mercurian craters (7) for Drc < 60km, but comparable on all three planets for Drc > 60km.

Morphology, Regional Variations - Central peaks occur in 69% (1452) of the complex craters studied, floor pits in 21% and pitted peaks occur in 10% of the craters studied. Central peaks are the dominent central structure type on all terrains except Elysium lavas, although pits occur in some craters on all terrains. No consistant increase in pit frequency with latitude was found. Fluidized ejecta deposits (possible substrate volatile indicators, (5)), were also found on all terrains at all latitudes with similar frequencies. However both these features vary in frequency with Drc (Fig. 3,4). Pits (floor pits or pitted peaks) and completely fluidized ejecta occur primarily at Drc = 20 - 55km , and pits are extremely rare for Drc > 70km.

Discussion - A link between pit formation and primary crater-forming processes is supported by the power-law relation defined for Dp/Drc. If pit formation requires the presence of substrate volatiles, the lack of strong dependances between pit frequency and terrain or latitude argues for a global distribution of volatiles in the substrate, with the highest percentage confined primarily to depths sampled by craters of Drc < 55 - 70km. The presence of a ballistic ejecta component and relatively reduced central peak diameters and crater depth/diameter ratios (8) for Drc > 60km support this interpretation. This depth may be roughly constrained by present apparent crater depths (8,9) and terrestrial central uplift sampling depths (1) to between 2.5 - 6.5km. Additional analyses to determine if depth dependances vary with substrate are currently underway.

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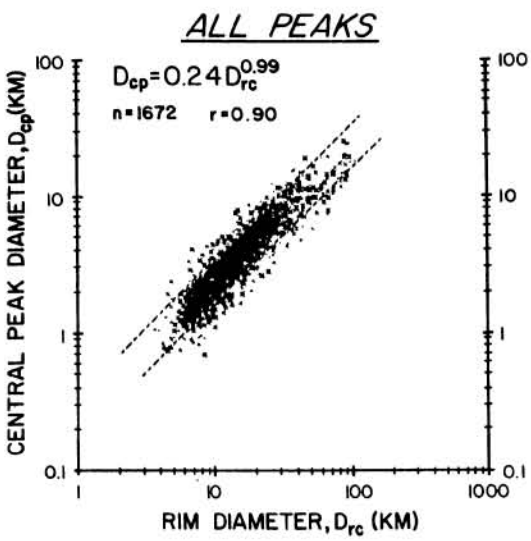
Figure 1 Figure 2

Dashed lines are $\pm 1\sigma$ about the regression equation.



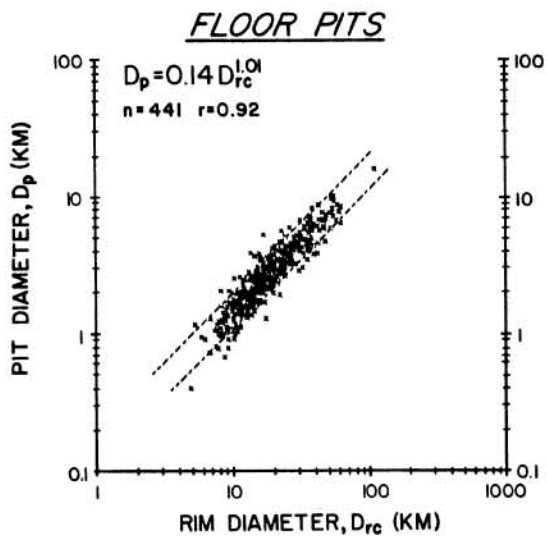


Figure 3

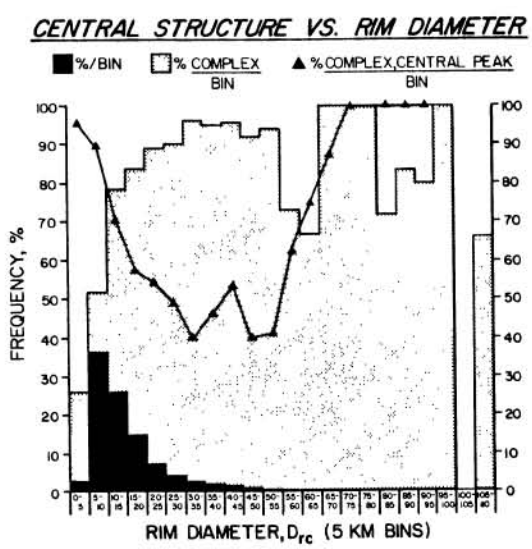


Figure 4