COMPARISON OF CENTRAL PIT CRATERS ON MARS AND GANYMEDE. N. G. Barlow, Department of Physics and Astronomy, Northern Arizona University, NAU Box 6010, Flagstaff, AZ 86011-6010. Nadine.Barlow@nau.edu.

Introduction: Impact craters with central pits are common on Mars and icy moons such as Ganymede but are rare on volatile-poor bodies such as the Moon. Central pits are generally believed to form from the explosive release of gases produced by shock vaporization of subsurface ice during crater formation [1], a theory which has recently gained support from numerical modeling of impacts into mixed ice-soil targets [2]. However, many questions remain about central pit craters, including why craters with central pits are often adjacent to craters of similar size and preservational age which do not display a central pit. In an attempt to gain a better understanding of the conditions under which central pits form, we are conducting a comparison study of central pit craters on Mars and Ganymede.

Martian Central Pit Craters: To date, we have identified ~1500 central pit craters on Mars using THEMIS data [3]. They are divided into floor pits, where the central pit lies directly on the crater floor, and summit pits, where the pit lies atop a central rise or peak (Fig. 1). Floor pits are approximately twice as common as summit pits (67% vs 33%, respectively).

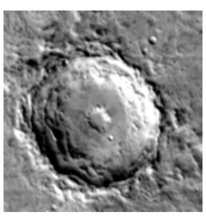


Figure 1: Examples of martian central pit craters. Floor pit (left) and summit pit (right).

Thus far we see no statistically significant difference in the distribution of floor pit craters versus summit pit craters: floor pits are seen between 51°N and 69°S while summit pits occur between 46°N and 67°S (higher latitudes have not been completely surveyed yet). Pit craters are concentrated on Noachian-aged highlands units. Although few central pit craters occur in the northern plains, those that do tend to be floor pits (Fig. 2).

Floor pits are found in craters ranging in diameter from 5 to 57 km. Summit pits are seen in craters over a similar diameter range: 6 to 49 km. Based on depth-diameter relationships, the lower diameter limit implies that these craters are excavating to depths of at least 500 m. We also have compared the pit diameter (D_p) to crater diameter (D_c) (Fig. 3). We find that floor pits have D_p/D_c between 0.07 and 0.28, with a median of 0.15. Summit pits are smaller relative to their parent craters, with D_p/D_c ranging between 0.05 and 0.19 and a median of 0.11.

Central pits are associated with craters in a wide range of preservation, indicating that conditions producing central pits have existed over most of martian history. Preservation class ranges from very degraded (2.0) to pristine (7.0) (see discussion of preservation scale in [4]). Of those central pit craters still retaining an identifiable ejecta blanket, most are associated with a multiple layer ejecta morphology.

Ganymede Central Pit Craters: Our survey has thus far identified 900 central pit craters on Ganymede using Galileo SSI and Voyager imagery. While some pits occur directly on the crater floor (like the martian floor pits), many others are located on top of a domed floor (Fig. 4). Dome pits outnumber floor pits 65% to 35%.

Central pit craters on Ganymede are strongly concentrated on low-albedo units, with the highest regional concentration occurring in Galileo Regio [5]. Central peaks and unpitted central domes also preferentially occur in these low-albedo regions, suggesting that ice-rock mixtures are more efficient at producing central features than impact into purer ice.

Dome pit craters range in size from 11.7 to 116.5 km while floor pit craters are between 12.4 and 94.4 km in diameter. Only a few pit diameters have been measured thus far, but those results indicate that small pits ($D_p/D_c < 0.2$ [6, 7]) dominate [5]. Central pit craters on Ganymede, like their counterparts on Mars, display a wide range in preservational state, indicating that the environmental conditions producing central pits in Ganymede craters have existed for much of the moon's history.

Comparison of Preliminary Results for Central Pit Craters on Mars and Ganymede: Although our study of central pit craters on Mars and Ganymede is still in its early stages, we are already beginning to see some interesting differences. If dome pit craters are the Ganymede equivalent of the martian summit pit craters, we see opposite trends in the numbers of floor versus summit/dome pit craters: floor pits dominate on Mars while dome pit craters dominate on Ganymede. The higher ice content in the Ganymede crust may enhance the formation of domed floors in impact craters, leading to this result. To date, we have identified no pits atop central peaks on Ganymede, unlike the case for Mars.

Central pit craters are generally larger on Ganymede than on Mars, although resolution may be affecting these results at the smaller crater diameter end. Nevertheless, central pit craters are more common at larger crater diameters on Ganymede than on Mars. This may be due to ice extending to greater depths in Ganymede's crust.

Terrain appears to have some influence on the formation of central pits. Central pits on Ganymede preferentially form on low-albedo geologic units while martian central pits favor the heavily cratered Noachian units. Apparently some mixture of ice and soil is needed to produce central pits on Ganymede, with purer ice detering central pit formation. On Mars, the highly fragmented Noachian units might preferentially accumulate the ice concentrations necessary for pit formation.

Future Work: Much work remains in our study of central pit craters on Ganymede and Mars. We need to complete our survey of pit craters on both bodies and will use MOLA to better constrain the floor characteristics of central pit craters on Mars. We will complete measurements of central pit diameters on Ganymede to obtain D_p/D_c ratios which can be compared with those of martian central pit craters. We will then look into how other factors, such as impact velocity and possible impactor composition, might influence central pit formation.

References: [1] Wood C. A. et al. (1978) *Proc. Of 9th LPSC*, 3691-3709. [2] Pierazzo E. et al. (2005), in *Large Meteorite Impacts III*, 443-457. [3] Barlow N. G. and Hillman E. (2006) *LPS XXXVII*, Abstract #1253. [4] Barlow N. G. (2004) GRL, 31, doi: 10.1029/2003GL019075. [5] Klaybor K. and Barlow N. G. (2006), *LPS XXXVII*, Abstract #1360. [6] Schenk P. M (1991) JGR, 96, 15632-15664 . [7] Schenk P. M. (1993) JGR 98, 7475-7498.

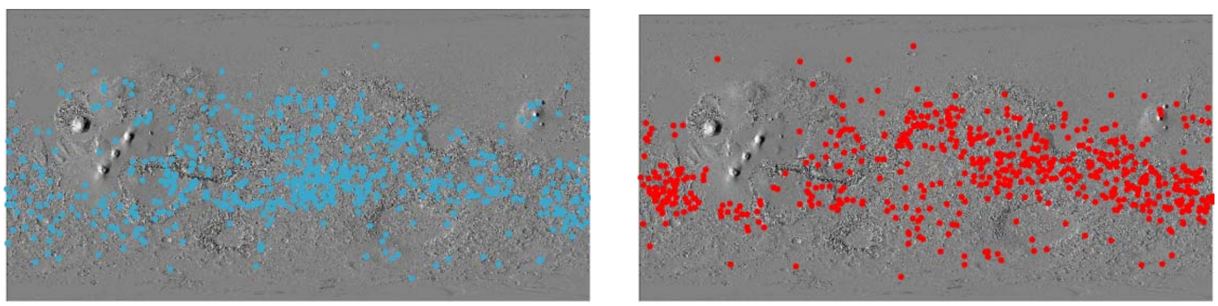

Figure 2: Distribution of floor pit craters (left, in blue) and summit pit craters (right, in red) on Mars.

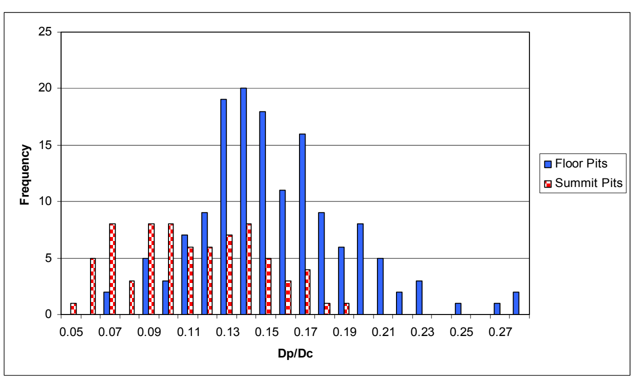

Figure 3: Comparison of pit diameter (D_p)-crater diameter (D_c) ratios for floor pits and summit pits on Mars.

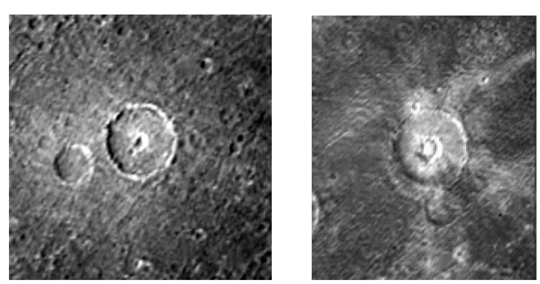

Figure 4: Examples of floor pit (left) and dome pit (right) craters on Ganymede.