DIMENSIONS OF CENTRAL PITS IN GANYMEDE CRATERS. V. J. Bray[1], P. M. Schenk[2], H. J. Melosh[1], G. S. Collins[3] and J. V. Morgan[3]. [1]Lunar and Planetary Lab., University of Arizona, Tucson, AZ 85721, USA. [2]Lunar and Planetary Inst., 3600 Bay Area Blvd., Houston, TX 77058, USA. [3]Imperial College London, Exhibition Road, London, SW7 2AZ, UK. vjbray@lpl.arizona.edu

Introduction: Central pit craters are an unusual class of impact crater seen most commonly on the icy Galilean satellites and Mars. They are characterized by terraced rims and flattened floors with a pit at or near the center (see Fig 1). Their association with ice-rich surfaces has led most hypotheses for the origins of central pits to rely on the volatility or weakness of water ice [e.g. 1, 2, 3, 4].

Knowledge of pit dimensions is necessary to reveal the depth of pit influence, and can also be used to infer the quantities of material involved in the formation process. Such information will have important implications for the development and testing of pit formation theories; for example, variation of pit volume in craters formed on different terrain types may indicate a material property dependence of the pit formation mechanism. We will present topographic profiles of central pit craters on Ganymede. Measurements from these data are used to construct scaling trends to be used in future testing of numerical models.

Method: Digital elevation models (DEMs) were created from Galileo Solid State Imager (SSI) images, with the use of the stereo scene-recognition algorithm developed by [6]. Once each DEM of a crater was obtained, spurious patterns or shape distortions created by radiation noise or data compression artifacts were removed through the use of standard image noise filters, and manually by visual inspection of the DEM and original image(s).

Four cross-sectional profiles were taken across each crater (Fig. 1); terrain type was noted so that any differences in crater trends on bright and dark terrains could be documented. Crater diameters were determined from an average of the 4 rim-to-rim distances. Measurement of other crater dimensions including pit depth and diameter were made from all profiles across each crater. Obvious outliers in these values were discarded and the maximum reasonable value adopted for each feature measurement; height and width values in this work should therefore be viewed as an upper

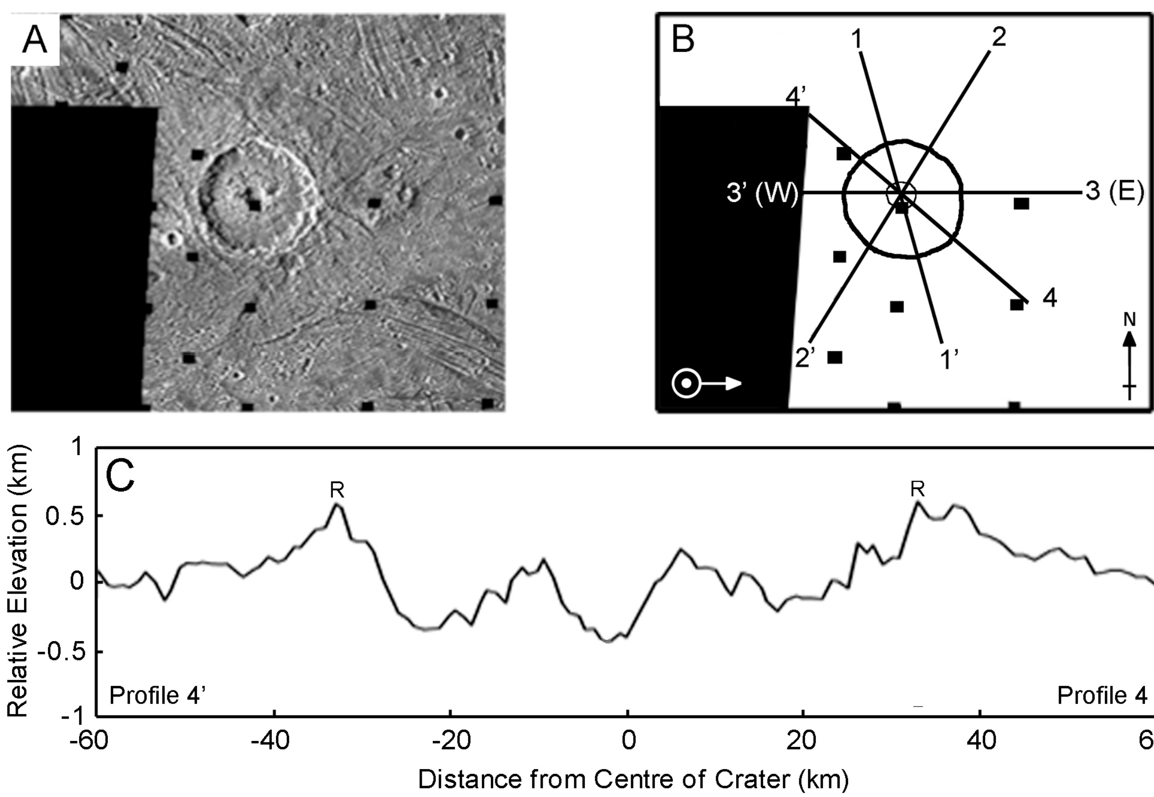

Fig. 1: A) Galileo image of a central pit crater on Ganymede at LAT,LONG. B) Sketch showing the lines along which profiles were taken. C) Topographic profile of the crater shown in A. 'R' marks crater rims, Vertical exaggeration is 60:1.

bound. This approach was favored above taking the average of all radial profiles, as the most accurate depth measurements of Ganymede are based on shadow measurements and are themselves maximum values [7].

Results: The relationship between central pit diameter and crater size on Ganymede has already been investigated [e.g. 5, 8], and show pits in Ganymede craters to be generally wider than their Martian counterparts [e.g. 9, 10], particularly at crater diameters above 70 km [4]. Data from this work supports existing Ganymede scaling trends, with pit diameters increasing exponentially with crater diameter (Fig. 2A). Pits in Craters below ~ 40 km in Diameter follow a similar trend on both Mars and Ganymede. At larger crater diameters the Ganymede and Martian trends diverge and the Ganymede pit diameters increase relative to the majority of their Martian counterparts. This difference is most obvious at crater diameters larger than 70 km, in which pits in Ganymede craters are consistently larger than those in Martian craters.

The relation of pit depth with crater diameter is presented in Fig. 2B. Pit depth increases with increasing crater size, following a power law. No variation in pit dimensions with terrain type was found. The new measurement of pit depth has allowed a simplified estimate of pit volume to be made in which pit shape is approximated as conical [4]. These data show pit volume increases as crater diameter increases (Fig. 2C).

Implications: Pit diameter, depth and volume all increase with growing crater diameter on Ganymede, following power law trends. No clear difference between the relative sizes of pits in different terrains was observed. This may be the result of low sample numbers in this work so far; terrain influence may be apparent with continued data acquisition and is still deemed likely as it has been noted previously [e.g. 5, 9]. Future estimates of volume using a more realistic calculation may also yield alternate results.

As the surface composition, target gravity and impact velocity differ between the two bodies, there are several possible explanations for the divergence in Martian and Ganymede pit diameters in craters above 40 km in diameter. Larger pits on Ganymede could suggest that the pit formation mechanism is more effective in higher ice concentrations. Alternatively the lower impact velocity on Mars (~10 kms^{-1} compared to 21 kms^{-1} on Ganymede) will result in lower post-shock temperatures relative to Ganymede, producing less melting and vaporization of target material [11].

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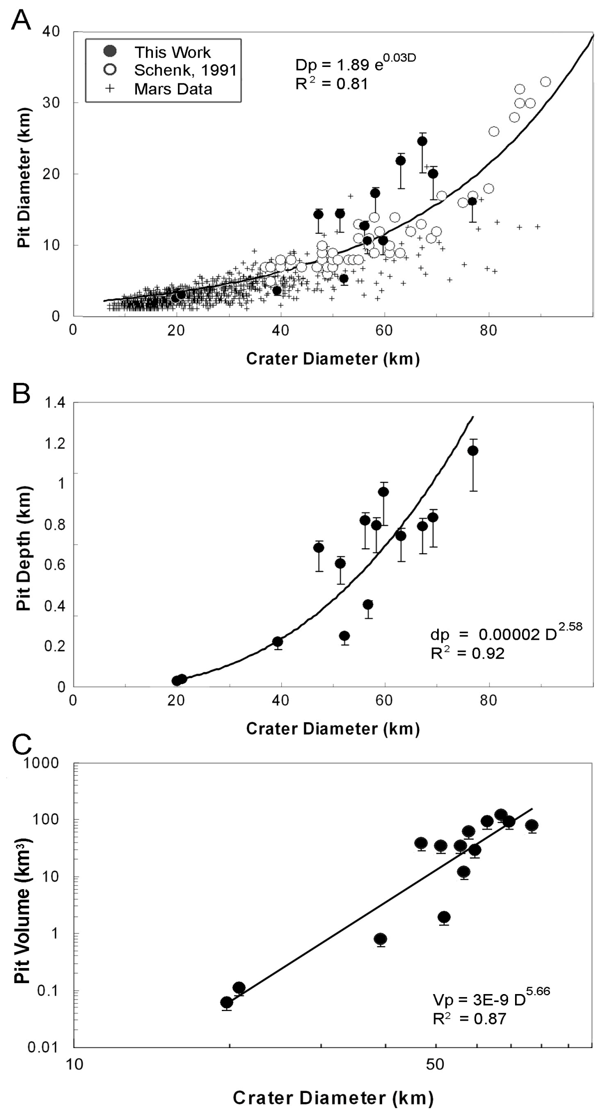

Figure 2: Pit dimensions in Ganymede Craters. A) Pit diameter relative to crater diameter; both Voyager-based measurements [8], and Galileo-based measurements from this work are plotted with Martian pit data from 9. B) Pit depth relative to crater diameter. C) Pit volume relative to crater diameter.