Detailed Analysis of Hydraotes Chaos, Mars. J. Walmsley[1] <jwalmsley@brocku.ca>, F. Fueten[1] <ffueten@brocku.ca>, R. Stesky[2], J. Flahaut[3], E. Hauber[4], [1]Dept. of Earth Sciences, Brock University, St. Catharines, Ontario, Canada L2S 3A1, [2]Pangaea Scientific, Brockville, Ontario, Canada K6V 5T5, [3]CRPG, CNRS/UL, 54501 Vandœuvre-lès-Nancy, France, [4]Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany.

Introduction: Chaotic terrain is a mixture of irregular knobs and ridges [1], with younger areas of chaos containing large smooth topped mesas which break up over time [1]. A variety of studies have investigated the formation mechanisms of chaotic terrain [2-5]. Most recently a sequence involving the destabilization of a subsurface frozen lake that filled a preexisting impact crater or depression has been suggested [6]. Previous studies have suggested the presence of a magmatic intrusion to provide a heat source for volatile loss [2-5]. Hydraotes Chaos is in an outflow channel located between Xanthe Terra and Margaritifer Terra, and drains into Chryse Planitia. Recent studies in the area have focused on hydrology [7] and volcanism [5] including the description of cones found primarily in the basin which resemble terrestrial cinder cones. Hydraotes Chaos is a large region of separated smooth-topped mesas. Many of these blocks possess terraces (Fig. 1B), which have been mapped and interpreted to be the result of the interaction of waves and ice in a frozen lacustrine basin [7]. Terraces have also been proposed to be the result of ponding in catastrophic floods [8]. This study uses new Digital Elevation Model (DEM) data and quantifies a variety of parameters to gain a better understanding of the formation of Hydraotes Chaos.

Methodology: A composite DEM at 50 m/pixel was created using 4 CTX DEMs and 6 HRSC DEMs (Fig. 1A). For 5% of the area only MOLA data was available. CTX DEMs were calculated with the NASA Ames Stereo Pipeline [9,10]. ArcGIS, ArcScene 10.5, and an Augmented Visualization of Attitude (AVA) tool [11] were used to compute strike and dip statistics of the mesa blocks. The AVA tools were also used to compute the strikes of the steep (10°-50°) sides of the blocks. The tops of 121 blocks were manually digitized and shape parameters were computed using a moment of inertia technique. For terraces that could be identified within the DEM, a single elevation point per terrace was used to construct a Triangulated Irregular Network (TIN) (Fig. 1D). Elevation points of the surrounding basin area were used to construct a basal TIN (Fig. 1C) for comparison. The volume of removed material from Hydraotes Chaos was calculated using the height of the surrounding plateau.

Results: The dip of the top of 132 blocks was calculated. Dip and dip direction are shown in Figure 1A. Dip values ranged from a minimum of 2° to maximum of 12°, with an average dip of 4.8°. Blocks dip weakly but not consistently towards the center of the basin. Statistical analysis of the strikes of the edges of blocks yielded a weak preferred orientation with a peak orientation of 1.7°. The aspect ratio of the top of the blocks was found to range from a minimum of 1.04 to a maximum of 2.64 with a mean of 1.49. The angle of the long dimension of the blocks shows a broad concentration between 150° and 190°, peaking at about 170°. Terraces could be identified in DEM for 69 blocks which were used to construct a TIN (Fig. 1D). Ninety-nine elevation points from the floor near the terrace points were used to create the basin TIN (Fig. 1C). Elevations for both datasets showed a decrease towards the center of the basin, away from the plateau. Variation in depths of the terraces generally mimics the depths of the basin floor. The total volume loss within Hydraotes basin was calculated to be 168,410 km^3 with an average collapse depth of 2.11 km.

Discussion: The long axes of the blocks shows only a weak preferred orientation. The lack of strong alignment suggests a lack of any underlying crustal control such as major crustal scale faults. The surrounding plateau dips ~2°, while average block dips are 4.8°. This suggests minimal rotation of blocks occurred during or after collapse. If the same flood event produced the terraces, they should share approximately the same elevation. Instead, the terraces mimic the shape of the floor. We suggest that this indicates that the final collapse to present day elevations might postdate the flooding that produced the terraces. The presence of cones may help in providing a timeframe for the final collapse, as they are small and appear to be well preserved and postdate the collapse.

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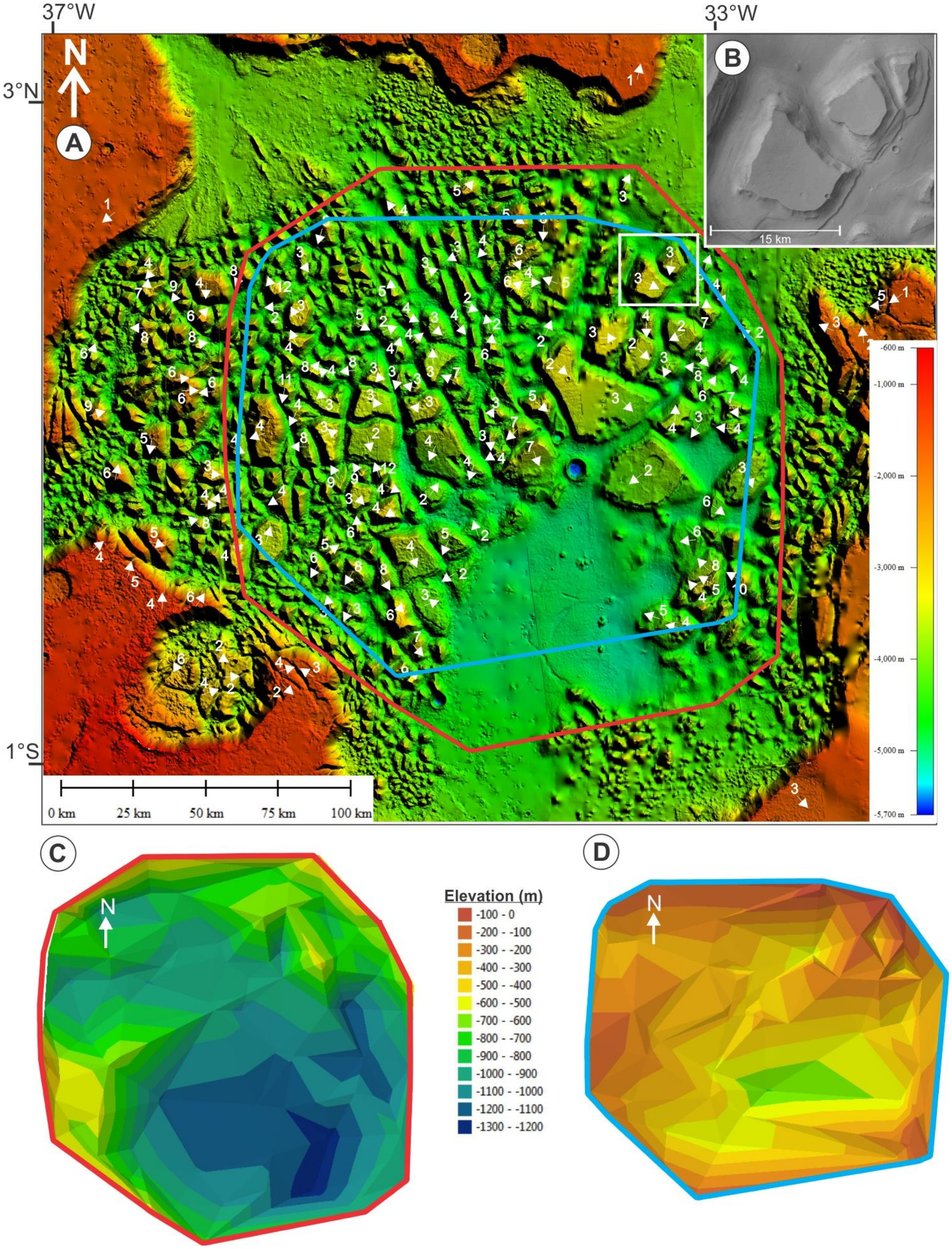

Figure 1: A) Composite DEM using CTX, HRSC, and MOLA DEMs, includes dip and dip direction of mesas and the surrounding plateau; B) CTX image of terraces surrounding mesa blocks; C) Basin TIN using 99 points, red outline in (A), D) Terrace TIN using 69 points, blue outline in (A). Elevation for both has been adjusted to the highest elevation point for terraces to provide a simplified depth scale.