RAMPART EJECTA VOLUME MEASUREMENTS IN XANTHE TERRA, MARS, USING MOLA: RELATION TO HRSC-CAMERA DERIVED AGE MEASUREMENTS.

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Introduction: We studied 32 craters with fluidized ejecta ramparts in Xanthe Terra, making measurements of their ages using crater-counts on the ejecta in HRSC images [1], and of the thickness and volume of the ejecta using MOLA data. The formation of this type of ejecta is generally attributed to the presence of volatile material, likely ground ice, in the target at the time of impact [2]. In this abstract, we use these measurements to investigate a) the relationship between the crater size and the volume of ejecta produced, in particular to consider how that might relate to the depth of a ground ice layer [3] and b) whether there has been any variation of this relationship over time [4, 5], which could throw light on the evolution of the ground ice.

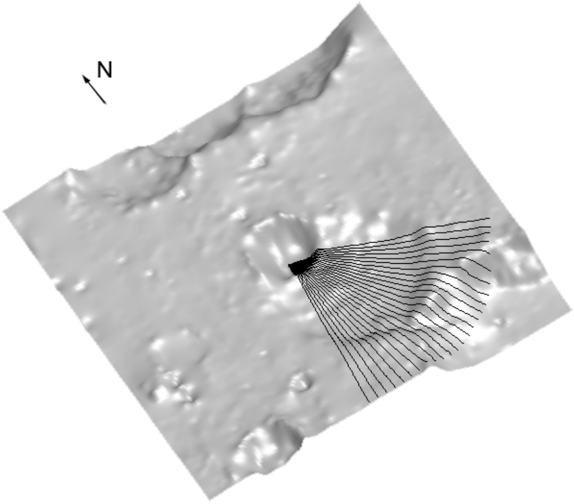

Fig 1. *MOLA shaded relief of 11.5km diameter rampart crater at 312.3E 4.2N. Series of rim/ejecta profiles taken where the ejecta overlie a larger crater floor.*

Method: A series of profiles are constructed from the centre of a crater over the rim and ejecta (Fig. 1). A range of directions is selected so that we avoid obvious dtm gaps, the prior surface appears as flat and even as possible, and that there there are no other apparent surface features which influence the profiles. From this series, we construct a mean profile and estimate the altitude of the prior surface (Fig. 2). The total volume of ejecta material at a given radius is taken to be the mean height above the prior surface multiplied by the circumference length: thus we estimate the total ejecta volume, assuming the ejecta are similarly distributed outside the region where the profiles were made (Fig. 3). The use of multiple profiles makes this extrapolation more reasonable. At present, we do not attempt to distinguish between the rim and ejecta, so the measure is simply the volume of displaced material.

For the example shown, of 11.5 km diameter, we obtain an ejecta volume of 4.8 km^3, with a typical ejecta thickness of 50 m. Another measurement made on the opposite side gave a volume of 8.2 km^3 – this second figure is probably somewhat overestimated, since the prior surface appears to have been inclined towards the south-east, and no adjustment was yet made for this.

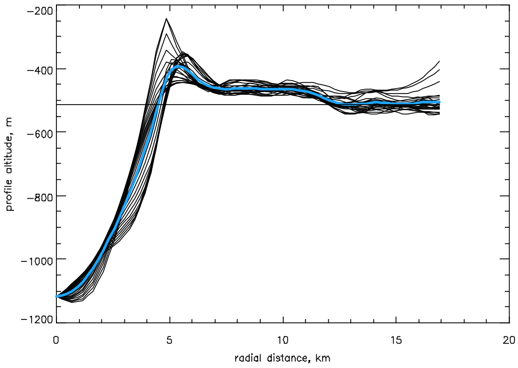

Fig 2. *Collated profiles from Fig. 1, with mean (blue) and interpreted prior surface level (here, the pre-existing crater floor).*

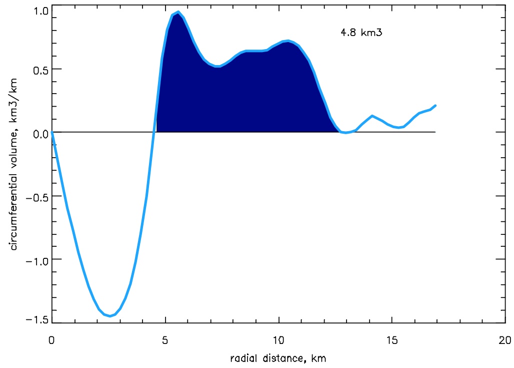

Fig 3. *Circumferential volume: the volume of material above the estimated original surface per unit radius. From the filled area, we can estimate the total ejecta volume (including rim), assuming the ejecta are simi-*

larly distributed outside the region where profiles were made.

Results: Fig. 4 shows the results for 17 crater ejecta volume measurements in Xanthe Terra. The plot shows the cube-root ejecta volume against the crater diameter, for which we could expect a linear dependence. A linear fit intersects the zero-volume level at a crater diameter of 6.3 km. This is an alternative method to obtain the ejecta onset diameter used to estimate the ground ice depth, and gives a result consistent with the 4-7 km onset diameter for equatorial regions [3], indicating an ice-rich layer at a depth of 300-400m.

We attempt to relate the measure of ejecta volume to the crater age, as determined from crater-counts on the ejecta [1] (Fig. 5). We use a dimensionless measure of the ejecta magnitude, $v^{1/3}/d$, in order to remove the diameter dependence. However, the range of rampart crater ages in this region is revealed to be rather narrow, so we have not yet been able to establish any relationship. In Chryse Planitia, where the rampart crater age range is greater [1], the results may be more fruitful.

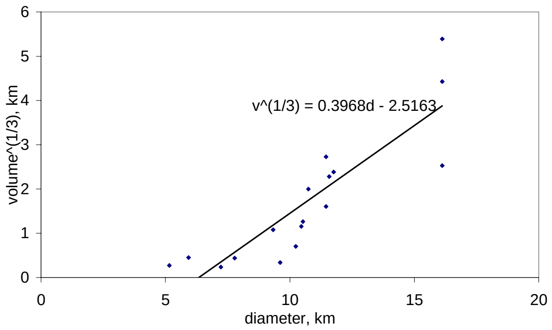

Fig 4. *Plot from 17 crater ejecta volume measurements in the region of Nanedi Vallis vs. crater diameter.*

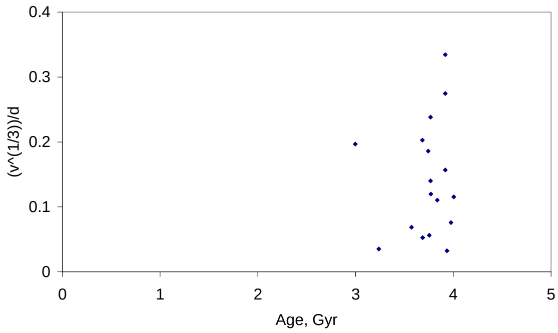

Fig 5. *Relative ejecta magnitude ($v^{1/3}/d$) vs. HRSC crater-count derived age. The range of rampart crater ages in this region is not so wide.*

We are also working on the optimization of DTMs from HRSC stereo images for the study of rampart ejecta, and have achieved some success in producing high resolution data (Fig. 6).

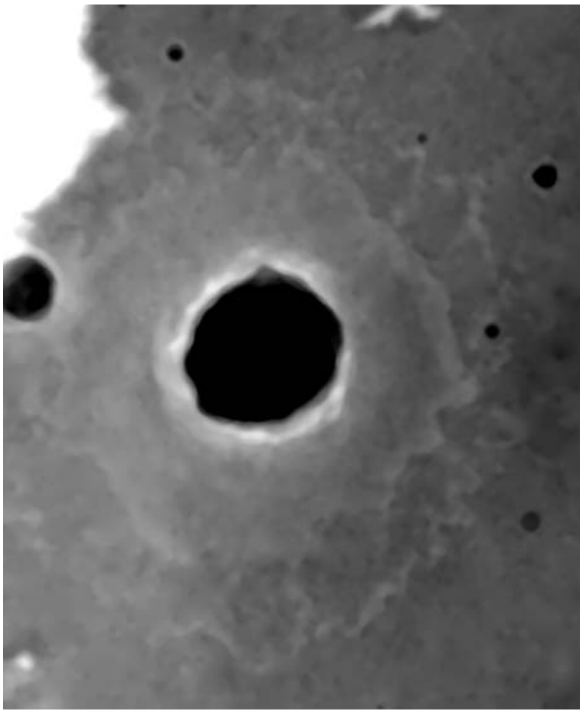

Fig 6. *HRSC DTM of 20km diameter rampart crater, orbit 1070, with 50m/pix resolution.*

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References: [1] D. Reiss et al. (2005) “Ages of rampart craters in the Xanthe Terra region and southern Chryse Planitia, Mars: implications for the distribution of ground ice in equatorial regions” *LPS XXXVI*, this vol. [2] Carr M. H. et al. (1979), *JGR, 82*, 4055-4065. [3] Kuzmin R. O. et al. (1988) *Solar Sys. Res., 22*, 195-212. [4] Squyres S. W. et al. (1992) in *Mars*, Univ. of Arizona Press, 523-554. [5] Barlow N. G. (2004), *GRL, 31*, 5703.