THE LINKS BETWEEN TARGET PROPERTIES AND LAYERED EJECTA CRATERS IN ACIDALIA AND UTOPIA PLANITIAE, MARS. E. Jones and G. R. Osinski, Centre for Planetary Science and Exploration/Dept. Earth Sciences, University of Western Ontario, 1151 Richmond Street, London ON, N6A 5B7, ejones68@uwo.ca.

Introduction: Martian craters with fluidized ejecta – including single-layered, double-layered and multiple-layered craters – have been studied extensively, with their formation generally suggested to be linked to varying concentrations of subsurface volatiles [1,2]. A new and extensive catalogue on martian impact craters [3,4] classifies crater ejecta along with their location, diameters and ejecta extents, potentially providing new information on the links between these morphologies and the subsurface. We examine this catalogue with an aim to identifying how these morphologies are interrelated within Acidalia and Utopia and how target properties may control the occurrence of layered ejecta. These regions have been previously identified as showing large numbers of Late Hesperian/Amazonian aged layered ejecta craters potentially related to past volatile rich sedimentary deposits [5,6].

Results: Single layer ejecta (SLE) craters smaller than 10 km diameter are the dominant impact morphology in Utopia, but large numbers of double-layer (DLE) craters are also present. Few craters within both Utopia and Acidalia do not show the layered ejecta morphology. From our study region, a crater in Utopia 3–12km diameter has a ≥70% chance of displaying layered ejecta. If layered ejecta is indicative of subsurface volatiles, then volatiles in Utopia were most strongly concentrated at the depths excavated by 7–9 km diameter craters (actual excavation depths not modeled here), and increase with diameter/depth up to this limit. The potentially high fraction of small (<5 km diameter) DLEs indicates that shallow volatiles may have been recently abundant at shallow depths (100s of metres) in Utopia, if the ejecta classification of these craters is accurate. This is consistent with radar evidence of possible substantial ice deposits at ~50–90m depth in Utopia [7,8].

Acidalia shows the highest preference for DLE craters. From Figure 1, for craters 6–11 km in diameter, there is a ≥50% probability that it will be a DLE. This indicates a significant association of DLEs to subsurface layers within this region and target conditions that are more favorable to the DLE morphology than SLE. Onset diameters of DLE craters in Acidalia are significantly deeper than typical for DLEs at that latitude, potentially related to the depletion of volatiles at shallow depths. This region is likely depleted in significant amounts of water ice within the top 1 km; although possible ice-rich material has been detected further to the south [9] and the water-equivalent-hydrogen content is 8% [10].

The catalogue ejecta extent data was also examined to calculate ejecta mobility ratios. High ejecta mobility ratios are taken to indicate lower effective viscosity of the ejecta flow, potentially related to higher entrained volatiles content [11]. Most SLE craters have a low ejecta mobility ratio <2. The highest values >3 are clustered within Utopia and Arcadia in the northern hemisphere and are associated with craters <10km diameter. These trends are, therefore, not determined only by latitude as clear regional correlations are observed [13].

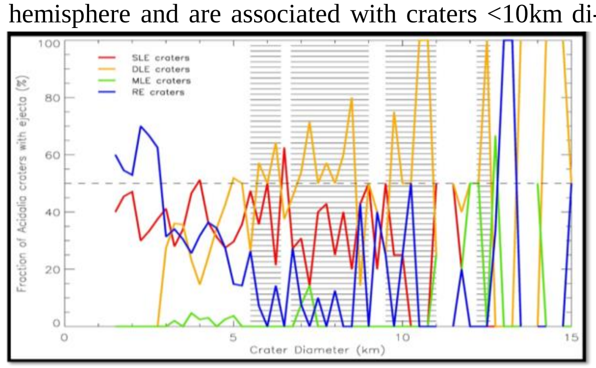

Figure 1: The proportion of each crater morphology within diameter bins in Acidalia. Craters in blue were identified in the catalogue as showing only radial ejecta. Excavation depth is proportional to crater diameter.

Conclusions: Our results indicate that craters with more than one layer of ejecta may be associated with subsurface volatiles, whereas single layered ejecta craters may be influenced more strongly by particle size and cohesion and be less sensitive to volatiles than DLE and MLE craters. Some sources of error and potential regions of mis-classification in the catalogue are identified.

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