PROXIMAL MULTI-LAYERED EJECTA OF THE HAUGHTON IMPACT CRATER (DEVON ISLAND, HIGH ARCTIC); INSIGHTS INTO EMPLACEMENT MECHANISMS OF LAYERED EJECTA. S. Thackrey[1,2], P. Lee[2,3,4], C. Mason[5], J. Parnell[1]. [1]University of Aberdeen, Aberdeen, AB243UE, UK. (s.thackrey@abdn.ac.uk) [2] Mars Institute, [3] SETI Instituture, [4] NASA Ames Research Center, Moffett Field, CA 94035-1000, U.S.A. [5]Dept. Physical Sciences, Morehead State University, Morehead, KY.

Introduction; We report the discovery of a well preserved, proximal multi-layered ejecta deposit on the NW sector of the Haughton impact structure [1]. This discovery provides evidence that subsurface volatiles plays a vital role in the emplacement of layered ejecta with evidence of a secondary atmospheric reworking phase. Ejecta morphologies observed on Mars, Venus, Earth, the Moon and Mercury differ significantly. With an atmosphere and an apparent volatile rich subsurface, Martian craters frequently display a proximal layered ejecta blanket that, in most cases, extends one crater diameter+ from the crater rim. These features are commonly referred to as fluidized ejecta or layered ejecta and are emplaced as a surface flow deposit [2], as a result of either atmospheric interaction [3] or subsurface volatiles [4]. The deposits are rarely preserved on Earth due to rapid removal by erosion. Until now, only Ries and Chicxulub have documented evidence of a preserved layered ejecta deposit [5].

An overview of the Haughton layered ejecta; The Haughton impact crater (23km diameter, 39 Ma) is remarkably well preserved. Field work over two field seasons (2006/2007), in the context of the Haughton-Mars project, focused on establishing the nature and extent of ejecta around the Haughton crater. The layered ejecta at Haughton (which we have named the Aberdeen Fm.) can be traced approximately 0.4 crater radii beyond the crater rim. Thicknesses of individual layers are highly variable from 3m to 6m+. Layers are typically brecciated in nature with clasts ranging from mm to m scales. Rafts of the regional geology (Middle Allen Bay Fm. dolomitic sandstone (see [6])) commonly occur and also vary significantly in size. Some rafts show ploughing of material in front of them that provides a sense of “flow” direction. The flow directions are consistently away from the crater. Various outcrop examples show that the ejecta was confined by the palaeotopography at the time of impact. This, coupled with the ploughing of material in front of rafts, suggests that the ejecta acted like a dense, ground-hugging debris flow.

The matrix is composed of fine calcareous sand. The ejecta exhibits extensive hydrothermally (alkaline vapour/liquid) precipitated calcite veins that do not occur in the regional geology. A striking feature of each individual layer is the variation in provenance of breccia clasts. Although the matrix supporting the clasts seems to be uniform throughout the ejecta sequences, breccia clasts range in composition and are interpreted to have sourced from various parts of the stratigraphy of the target sedimentary sequence at Haughton [6]. The layered ejecta that is preserved closest to the rim exhibits a minimum of 3 layers of ejecta, each identified by its unique clast type.). Crystalline basement clasts, which are observed extensively in the impact breccias, do not occur in the layered ejecta deposits.

The boundaries between each ejecta deposit is highlighted by a calcareous sand layer (Thickness varies between 30cm to 1m+) that is very similar in character to the matrix. This layer shows extensive high energy, chaotic soft sediment deformation features (Fig.1). These are commonly in the form of pervasive convolute loading/shearing structures and rip-up clasts. These horizons are interpreted as sheer or glide planes similar to those discussed in [4].

Fig. 1. Dark clast breccia resting on the calcareous sand glide plane. The base of the hammer is resting on the regional geology (middle Allen Bay fm.).

Emplacement mechanisms and discussion; Figure 2 shows an extrapolated cross-section of the layered ejecta outcrop closest to the crater rim. It shows three layers of ejecta, each with a different clast type. The variation in clast type facilitates correlation to other outcrops further from the crater rim.

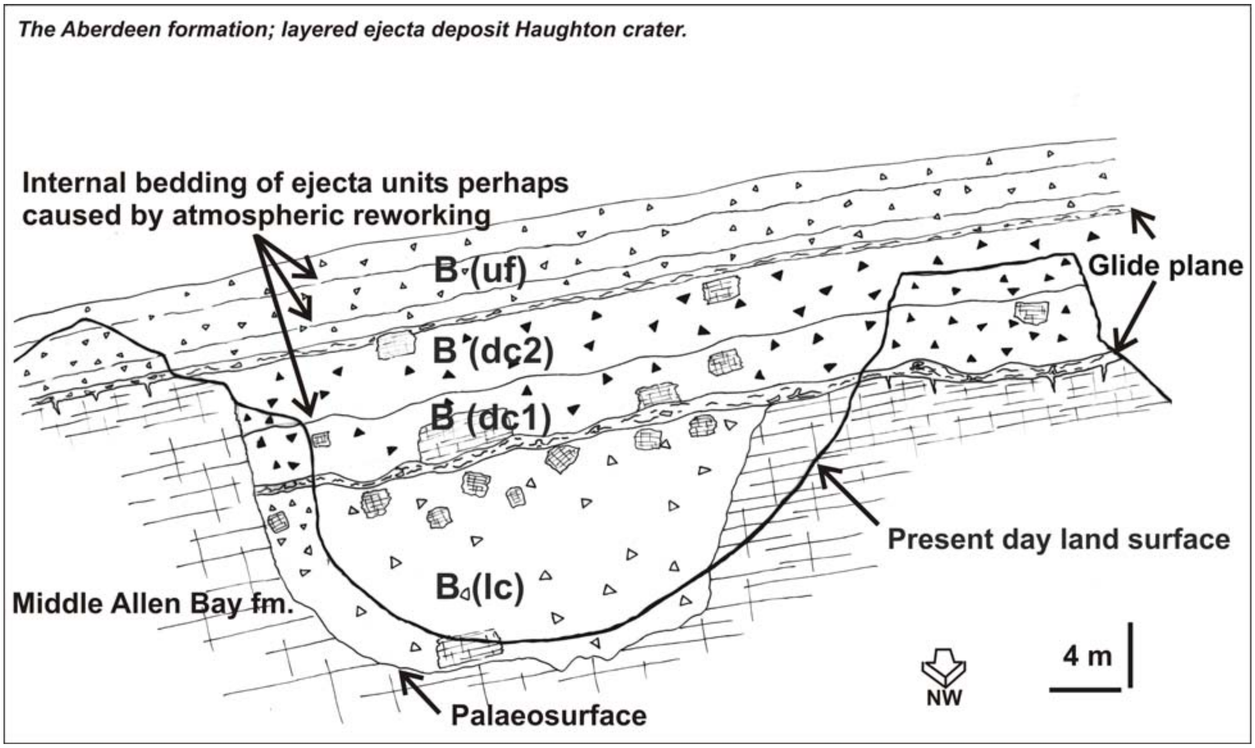

Fig. 2. An extrapolated cross-section of the Aberdeen Fm. layered ejecta deposit nearest the crater rim looking towards the crater centre (perpendicular to flow direction). B(lc)=breccia with light clasts, B(dc1&2) Breccia with dark clasts (note the internal reworking surface dividing sub units 1 and 2), B(uf)=Breccia upper fine. Boundary between successive units is typified by highly fluidized glide planes. The upper fine breccia is believed to be associated with atmospheric reworking due to its fine nature, lack of hydrothermally emplaced calcite, and well defined thin (1m scale) horizontal bedding.

From field evidence, it is apparent that the flows would have been emplaced as a high energy, dense and ground hugging flow. Due to the presence of pervasive hydrothermally emplaced calcite, the ejecta would have been hot during deposition and would have had a volatile component. In this case, alkaline water liquid/vapour. The slurry-like nature of the glide planes also indicates that fluids constituted an important part of the ejecta's lateral progradation. The B(uf) unit part of the Aberdeen Fm. seems to be associated with an atmospheric emplacement due to the lack of any identifiable hydrothermal calcite (cold and/or dry emplacement), fine breccia clasts, comparatively thin horizontal bedding structures, and lack of large rafts of regional geology.

Further work will focus on investigating the temperature of emplacement, provenance of breccia clasts, and extent of the layered ejecta. This will provide additional insights into the mechanisms and processes involved during the deposition of layered ejecta both on Earth and Mars.

Acknowledgements: This work was supported by the Mars Institute, NASA, and the University of Aberdeen. Thanks to Wesley Smith, Megan Ennis and Bill Atwood (undergraduates from MSU) for their kind support in the field.

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