Characteristics of Crater Floor Deposits in the Ares Vallis Region N. H. Warner[1], S. Gupta[1], S. Lin[2], J. Kim[2], J. P. Muller[2], J. Morley[3] [1]Dept. Earth Science & Engineering, Imperial College London, South Kensington Campus, SW7 2AZ, UK, n.warner@imperial.ac.uk. [2]Mullard Space Science Laboratory, Department of Space and Climate Physics, University College London, Holmbury St. Mary, Surrey, RH5 6NT, UK, [3]Centre for Geospatial Science, Sir Clive Granger Building, University of Nottingham, University Park, Nottingham, NG7 2RD, UK.

Introduction: Several medium to large diameter (D > 8 km) impact crater basins are present on the Late Noachian-Early Hesperian highland surfaces surrounding the Ares Vallis outflow channel [1]. Of these craters, some contain single, sinuous outlet channels which imply the past presence of crater lakes [2]. Additionally, several large diameter craters occur within the confines of the Ares Vallis outflow channel and show evidence for rim modification and breaching by floods. Using high resolution CTX, HiRISE, HRSC, and THEMIS images we have identified infilling deposits within both classes of craters. These materials show a variety of surface morphologies that may be linked to specific fluvial-lacustrine and periglacial processes.

Highland Craters with Outlet Channels: Four impact craters on the highland terrain surrounding Ares Vallis contain single, sinuous outlet channels and lack inlets or gullying on the interior crater walls. Furthermore, there is no evidence for modification of the highland craters by floods, indicating that these craters are located beyond the extent of past flood activity. Groundwater sapping into the crater basins is therefore the most likely mechanism for water infill.

CTX images of the infill material within the highland craters with outlet channels reveal smooth layered deposits that embay the interiors of the crater rims (thickness estimate = 300 m – 600 m). The surface of these deposits are marked by three distinct morphologies that include: (1) polygonally fractured terrain (Fig. 1) (2) smooth terrain and (3) smooth terrain with small conical mounds. Three out of four observed crater floors exhibit polygonal fractures that are concentrated at specific locations on the surface of the deposits. The polygons are ~ 30 m – 100 m wide and are similar in scale to purported de-hydration polygons identified on the floors of other former Martian crater lakes [3]. Smooth terrain is present within all the outlet channel craters, but often transitions to polygonal terrain where dust cover has been removed. One outlet channel crater, located at 5.5° N, 337.4° E, contains interior conical mounds that resemble either relic ice-cored pingos or rootless volcanic cones.

Ares Vallis Flood Modified Craters: Located at 2.5° N, 344.0° E is a 70-km-diamter impact crater that is cross-cut by the 1-km-deep eastern branch of Ares Vallis. Within the crater, the flood channel bisects layered deposits that exhibit lobate to oval flat-floored depressions on the surface. The morphology of these features is most consistent with thermokarst pits on Earth and Mars, which form by sublimation or melting of near-surface ice [4, 5]. HiRISE images taken from the interior of the depressions reveal poorly developed meter-scale layering with evidence of discontinuous and structurless bedforms. We hypothesize that flood deceleration within this broad channelized region of Ares Vallis deposited water-saturated flood sediments. Freezing of the water within the sediments and subsequent ice degradation may explain the formation of the thermokarst depressions [4].

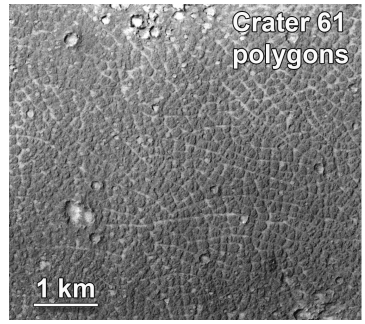

Fig. 1: CTX image of polygons on the floor of a crater with an outlet channel near Ares Vallis [2].

Discussion and Conclusions: From crater statistics and relative relationships between the crater outlet channels and the Ares Vallis system we suggest that the highland craters in the region were infilled with water/sediment during the Late Noachian/Early Hesperian. However, drainage and outlet channel formation occurred only after a delay of 100 Ma – 900 Ma in the Late Hesperian/Early Amazonian.

In contrast, crater statistics and relative relationships with Ares Vallis outflow channels indicates that the infilling sediments and thermokarst-like depressions in the flood modified impact crater formed during the Late Hesperian, near 3.3 Ga – 3.0 Ga [4]. Interestingly, the timing of highland crater drainage corresponds closely to the regional formation of thermokarst terrains. This may indicate a genetic relationship between the features controlled by regional climate warming and melting of near-surface ice.

References: [1] Nelson, D. M., and R. Greeley (1999), JGR, *104*(E4), 8653-8669. [2] Warner et al. (in press) JGR. [3] Maarry, M.R. et al. 2010, LPSC 1650. [4] Warner et al., 2010, Geology [5] Costard, F., Baker, V, 2001, Geomorphology.