PALEO-LAKES IN CENTRAL PIT CRATERS ON MARS.

S. E. Peel[1] and D. M. Burr[1], [1]University of Tennessee, Knoxville (speel1@vols.utk.edu).

Introduction: Potential paleo-lakes on Mars have been proposed since early observations of Mars (e.g., [1-2], and citations therein). Previous identifications of paleo-lakes have been based on the identification of outlet channels, fan-shaped deposits, terrace features and smooth deposits (e.g., [1], [3-6]). Many of these paleo-lakes are in the form of crater lakes (e.g., [1], [3-7]) though other examples exist (e.g., [8]). In a previous study [1], the ages of the analyzed craters were found to be Middle to Late Noachian in age (based on the unit in which they occur), while the lakes they contain were predominantly Late Hesperian to Early Amazonian in age, based on stratigraphic position and crater counting.

In previous work [9], 96 central pit craters (CPCs) were identified with inlet valleys that may have provided water to form lakes. Of those 96, five CPCs were discerned as having characteristics consistent with paleo-lakes, namely: (1) a putative outlet channel that may have drained a lake and (2) the presence at inlet channel mouths of sedimentary fans, potentially deposited by water [9]. However, this analysis included only five of the 96 CPCs with inlet valleys. In this work we analyze all of these CPCs.

Hypothesis: This investigation tests the hypothesis that the pits of these 96 CPCs with inlet valleys once hosted paleo-lakes. This hypothesis is tested on each CPC individually using multiple criteria (below).

Methods: The craters analyzed in this investigation are those CPCs with inlet valleys [9] that do not show heavy mantling so that any features of interest would remain discernable. The criteria include (1) outlet channels from the central pits onto the surrounding crater floor, (2) sedimentary fans adjacent to inlet channel mouths with concave down longitudinal profiles consistent with deltas, (3) lake sedimentary structures, (4) fan sedimentary structure, and (5) spectral analysis of exposed deposits to identify any evaporite deposits that may be present. We here report our results for criteria 1-3.

Outlet channel identifications were made using High Resolution Stereo Camera (HRSC) [12], Context Camera (CTX) [13] stereo pair and High Resolution Imaging Science Experiment (HiRISE) stereo pair DEMs. Outlet channels were identified by overlying CTX imagery of the crater with the available DEMs. At this time, the HRSC and CTX analyses (46 total craters) have been completed and have as yet only confirmed an outlet channel previously identified using Mars Orbiter Laser Altimeter (MOLA) [14] data ("crater 5" of [9]). HiRISE DEMs are currently being processed using Ames Stereo Pipeline [15] to expand this analysis to the ~10 additional CPCs with inlet valleys covered by stereo pair HiRISE images.

The identification of sedimentary fans with concave down longitudinal profiles has been completed for CPCs covered with HRSC and CTX DEMs and not having evident erosion. Thus far, we have taken profiles down six fans in three craters. Two of the six fans are unambiguously concave down (e.g., Fig. 1). The other four fan profiles approximate straight lines more consistent with alluvial fans than deltas. HiRISE DEM analyses will be completed on 6-7 additional fans once the DEMs are constructed.

The identification of desiccation cracks was made using HiRISE imagery. Of the inspected craters, one crater, at -10.21^{o}N, 146.49^{o}E, contains a polygonal texture on both the crater and central pit floors (Fig. 2), consistent with large mud desiccation cracks and polygonal fracture textures in evaporite deposits previously identified on Earth (e.g., [16-17]). These large desiccation cracks on Earth have been measured at 10-300m in width with crack widths of ~0.6 to a few meters and occur in particularly thick mud deposits [16-17]. The polygonal texture identified in the CPC shows a range of polygon widths from a few meters to tens of meters. The crack widths have been measured at ~1.5m to ~3.5m (one particularly large crack measured at ~7m). On top of this texture, we occasionally find small (few-meter-diameter) craters that occasionally exhibit lighter toned deposits along one common side (~NW) that may be an eroded deposit (duststone? [18]). These light-toned deposits may have acted to preserve this polygonal texture against the current erosive conditions of Mars.

Our current results are summarized in Table 1. Analyses of the fan sedimentary structures and spectral analyses of deposits (criteria 4 -5) are currently underway, and will be presented at the conference.

References: [1] Cabrol, N. A., Grin, E. A. (1999) *Icarus, 142,* 160–172. [2] Fassett, C. I., Head, J. W. (2008) *Icarus, 198,* 37-56. [3] de Hon, R. A. (1992) *Earth, Moon, and Planets, 56,* 95-122. [4] Cabrol, N. A., Grin, E. A. (2001) *Icarus, 149,* 291-328. [5] Malin, M. C., Edgett, K. S. (2003) *Science, 302,* 1931-1934. [6] Fassett, C. I., Head, J. W. (2005) *Geophys. R. Letters, 32,* L14201, doi:10.1029/2005GL023456. [7] Ori, G. G. et al. (2000) *Geophys. R. Letters, 105,* 17629-17641. [8] Irwin, R. P. et al. (2002) *Science, 296,* 2209-2212. [9] Peel, S. E., Fassett, C. I. (2013)

Icarus, 225, 272-282. [10] McEwen, A. S. et al. (2007) *JGR, 112,* E05S02. [11] Viviano-Beck, C. E. et al. (2014) *J. Geophys. R., 119,* 1403-1431. [12] Hauber, E. et al. (2006) *First MSL Landing Site Workshop, abs.* [13] Shean, D. E. et al. (2011) *LPSC, 42,* abs. no. 2646. [14] Smith, D. E. et al. (2001) *J. Geophys. R., 106,* E10, 23689-23722. [15] Moratto, Z. M. (2010) *Proc. LPS., XLI,* abs. no. 2364. [16] Neal, J. T., Motts, W. S. (1967) *J. of Geol.,* 511-525. [17] Neal, J. T. et al. (1968) *GSA Bulletin, 79,* 69-90. [18] Geisller, P. E. (2014) *LPSC, 45,* abs. no. 1621.

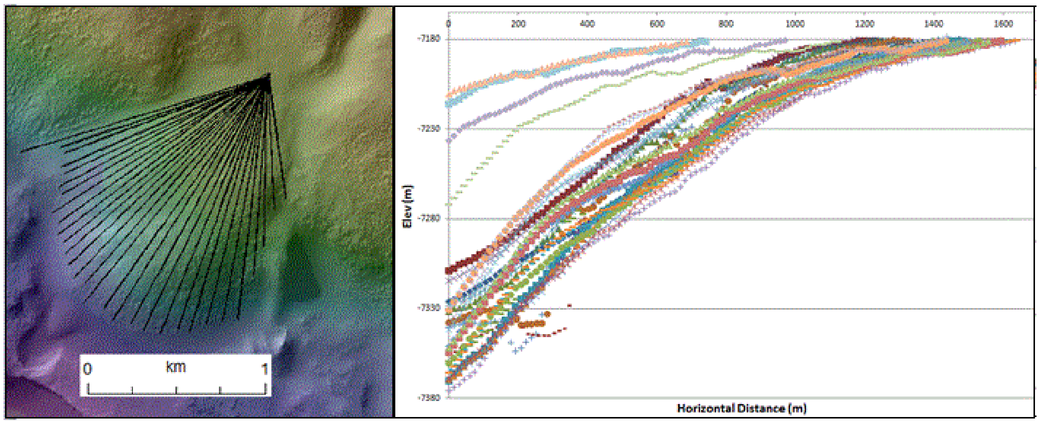

Figure 1: (Left) Fan in central pit near -36.3N, 158.22E, shown with CTX DEM. (Right) Profiles with locations shown in left image. The x-axis ranges from 0 to 1700 meters. The y-axis spans 200 meters in elevation.

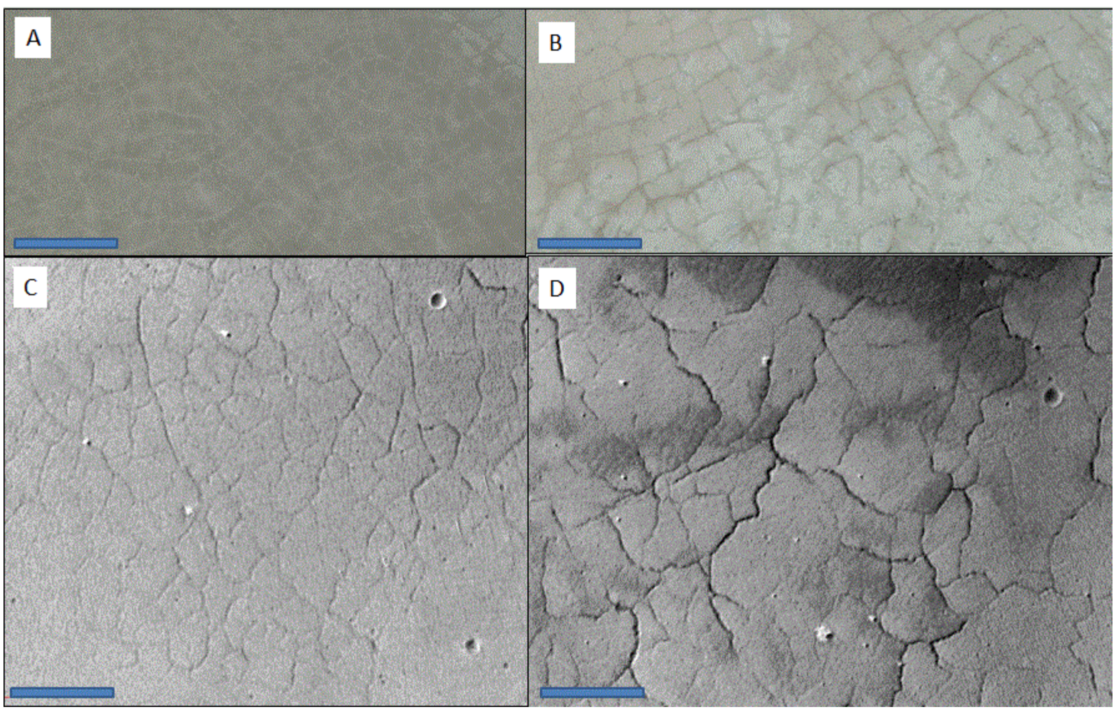

Figure 2: (A-B) Large desiccation cracks near Death Valley (near 35.07°N, -116.77°E; [16-17]; GoogleEarth). (C-D) Polygonal pattern ground in and around the central pit of a CPC centered at -10.21°N, 12.36°E (HiRISE image ESP_033825_1695). The blue scale bar is ~60m in each image.

Criterion	Number of Identifications
Outlet Channels	1 (+3 under investigation)
Concave Down Fan Profiles	2 of 6 fans with DEMs
Lake Sed. Structures	1 of 2 discernable on CPC floors

Table 1: Results in support of the hypothesis of paleo-lakes for the analyses that have thus far been completed.