New Alcove Activity in Lyot Crater: A Modern-day Mystery in the Martian Mid Latitudes. J. M. Widmer[1] and S. Diniega[2]. [1]University of Maryland (jwidmer@terpmail.umd.edu), [2]Jet Propulsion Laboratory, California Institute of Technology (serina.diniega@jpl.nasa.gov).

Introduction: Triangular shaped erosional features actively forming on the brinks of sand dunes in the North Polar Region (NPR) of Mars were first analyzed in 2011 [1]. Since then, efforts to constrain the formation mechanism of these features have advanced significantly. Analysis of these features, called alcoves, has determined that their formation occurs during the northern autumn/ winter and are hypothesized to form from surface-volatile interactions with the atmospheric CO_2 cycle present on Mars [2, 3, 4]. However, because these alcoves are forming in the late autumn and winter, visibility during the time of formation is obscured due to the autumnal martian polar hood and winter night [2]. Therefore, a new strategy was needed to continue investigating alcove formation mechanisms.

Studying alcoves forming on dune slopes over a wider range of latitudes will allow us to more highly constrain the driving environmental conditions active during alcove formation. In particular this investigation will provide information on the types of frost formation in the study areas; CO_2/ H_2O and seasonal/ diurnal frost. Therefore, we will establish a robust connection between surface frost-formation conditions and these alcoves, allowing this geomorphogical feature to serve as a proxy indicator of local-scale frost conditions on the martian surface, in the present climate.

Framework: The martian Mid-Latitude Region (MLR), spanning 30-65°N, was chosen as the new target for observing alcove activity because it marks the maximum extent of the boundary for seasonal frost [6] and provides better visible imaging conditions during both autumnal polar hood and winter night. Initially, 12 dune fields, identified in this study, as F1-F12 were located in the MLR through a survey of the Mars Global Digital Dune Database (MGD3) [7]. Via visual inspection of well-illuminated, defrosted HiRISE images, alcove activity was initially found only in Lyot crater in fields F3 (e.g., Figure 1), F5-F6. Lyot crater is the deepest point in the northern hemisphere [5] which led us to hypothesize that elevation played a role in alcove formation.

A separate inquiry of elevation selected craters used a combination of MOLA elevation data and CTX/ HiRISE images to identify 4 additional MLR dune fields with alcove activity outside Lyot at F13-F16. These additional dune fields were not originally cataloged in the MGD3 [7] and similar searches, within the MLR, will be made as this project continues.

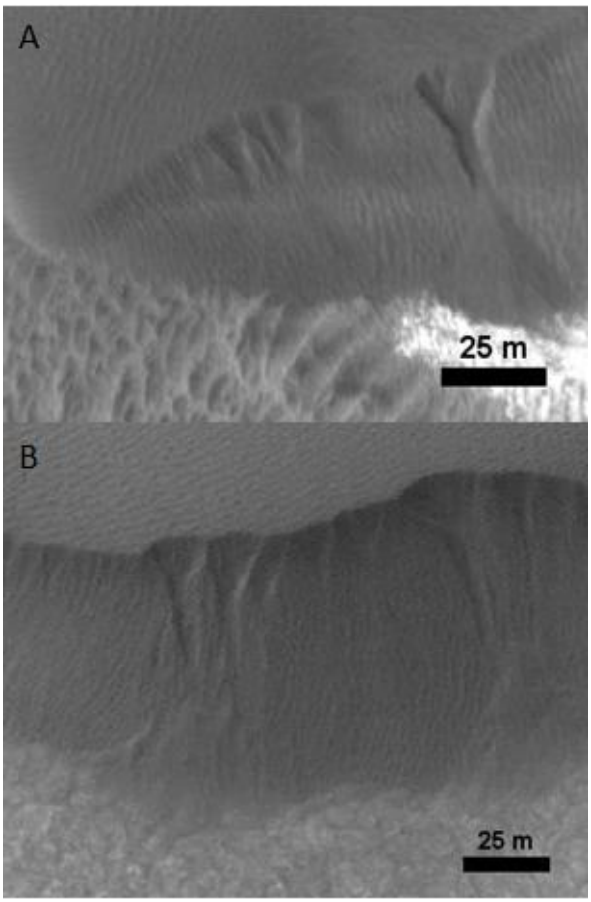

Figure 1: *Alcoves appearing in the MLR, shown here in F3 of Lyot Crater (A: 50.3°N, 28.9°E), appear very similar to those in the NPR, represented here by alcoves in Palma dune field (B: 76.2°N, 95.4°E).*

Comparing Dune Characteristics: In order to assess whether alcoves forming in the MLR may be analogous to those found in the NPR, we compared the environment in which the dunes formed and the types of dunes present in each field provided by the MGD3 [7]. We also compared average slipface distance, brink shape, dune size, and dune orientation within the field.

Field 3 Measurements: During our preliminary alcove activity search in Lyot Crater we found Field 3 (F3) to be the largest dune field and the most visually active. To quantify this claim, measurements of alcove length and width as well as alcove and dune brink orientations were measured through a comparative HiRISE image analysis. Analysis involves the visual inspection of two frost free HiRISE images which cover the same location but images compared are separat-

ed by 1 Mars year. This technique has been used to detect and catalog alcove activity in the NPR [4].

Frost Search: Seasonal frost in the northern hemisphere has been known to extend as far south as 32°N [6]. This places most the MLR and all of our selected study sites within the zone of seasonal frost formation.

As we aim to ascertain the environmental conditions necessary for alcove formation in the MLR, we have conducted a prelimary search for seasonal frost. This search extended over the entirety of the Lyot Crater basin and utilized visual inspection of CTX, MOC, and HiRISE datasets. We have also begun compiling a simplistic model to estimate surface temperatures during the time of expected frost formation.

Results & Discussion: The type of information used to compare the MLR and NPR dune fields is shown in Table 1 – specifically for the fields present in Lyot Crater, and NPR fields (Palma and Buzzel, which we determined to be most consistent.) The referenced Lyot dune fields are shown in Figure 2.

Field #	Dune Type	Visual Size	Projected Slip Face Dis. (m)	Brink Shape
F3	B, Bd	Lrg/ Med	70	Sharp
F4	B	N/A	N/A	N/A
F5	B, Bd	Small	23	Sharp
F6	B	Small	28	Sharp
Palma	B,Bd	Lrg/ Med	90	Sharp
Buzzel	B,Bd,T	Small	23	Sharp

Table 1: *Barchan (B), Barchanoid (Bd) and Transverse (T) dune types identified by the MGD3 [7] and data collected from our analysis of Lyot Crater, Palma, and Buzzel Dune Fields show consistency in dune characteristics. We also find some consistency in these fields (e.g., Fig.1).*

Table 2 compares our F3 alcove size and activity measurements with comparable measurements of NPR dune fields Palma and Buzzel, as reported in [4]. The data presented for F3 correlates nicely with the Palma and Buzzel data. The consistency present in the data presented by Tables 1 and 2 leads us to believe that alcoves appearing in the MLR have the same formation mechanism as those in the NPR.

However, preliminary seasonal frost search results have been inconclusive. In addition to the inherent difficulty of finding seasonal frost at such a low latitude as it appears for far less of the year and will not be as thick and/ or uniform as in the polar region, bright patches of exposed bedrock in the crater floor, as evidenced by Figure 1A (lower right corner), have added a layer of complexity to the frost identification process.

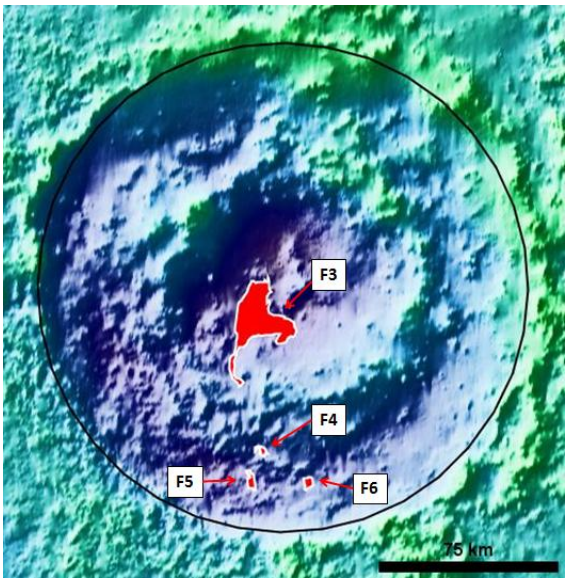

Figure 2: *The spatial distribution of MGD3 categorized dune fields (F3-F6) inside Lyot Crater, overlaid on a MOLA colorized elevation map (purple-to-green spans approximately -7000m to -2500m).*

Field #	MY	% Dunes Active	# New Alcoves	Alcove Volume (m^3)
F3	31	20%	197	0.3-11
	32	20%	233	0.5-16
Palma	29	50%	192	~117
	30	35%	154	13
	31	40%	158	7
Buzzel	30	5%	57	~14
	31	8%	97	~23

Table 2: *Field 3 measurements collected from HiRISE comparative image analysis, with representative NPR dune field measurements from [4].*

Acknowledgements: This work was supported by MDAP grant NNN13D465T. Additionally we thank Sylvain Piqueux (JPL) for his consultation; THEMIS and HiRISE instrument teams; the JMARS software developers; and Caltech SURF and JPL Education Office for the opportunity to develop this project.

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