REMOTE SENSING ANALYSIS OF ASKJA PUMICE MEGARIPPLES IN THE VIKURSUNDAR, ICELAND AS AN ANALOG FOR MARTIAN TRANSVERSE AEOLIAN RIDGES. S. P. Scheidt[1] and L. E. Bonnefoy[1], C. W. Hamilton[1], S. Sutton[1], P. Whelley[2], and A. P. deWet[3], [1]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ USA, [2]NASA Goddard Space Flight Center, Greenbelt, MD, [3]Franklin and Marshall College, Lancaster, PA.

Introduction: Observations of migrating sand ripples and dunes on Mars [1] show that aeolian processes continue to shape the surface of the planet. Transverse aeolian ridges (TARs) are a unique class of stable aeolian bedform with a wide variety of morphologies [e.g., 2] and an unknown particle size distribution. Rover observations on the surface of Mars can provide insight into their local characteristics [3], but the sedimentology of TARs is likely to vary between locations. Geissler et al. [4] hypothesized that martian TARs originate from indurated dust deposits. Because of their stability, morphology and formation mechanisms, a number of large wavelength and amplitude aeolian megaripples with granule to gravel-sized particles have been used as terrestrial analogs for martian TARs [e.g., 5]. The Lut Desert of Iran, containing megaripples composed of 3–4 mm sized grains, has also emerged as a site of martian morphological comparisons [6, 7].

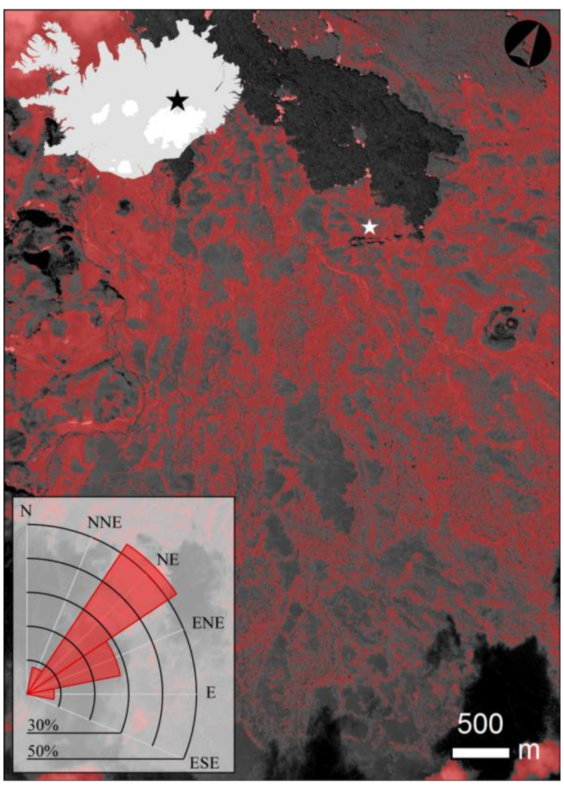

***Figure. 1**: The classification of multispectral data (red overlay) highlights the distribution of megaripples. The distribution of crest orientations indicate a prevailing NE migration. The white star marks repeat UAV aerial survey locations in 2015 and 2016.*

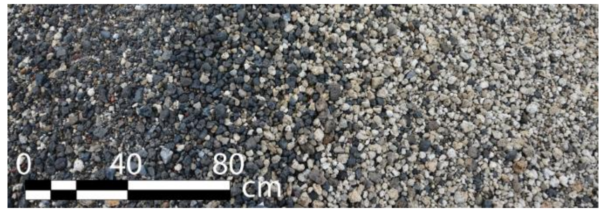

***Figure 2**: Surface observation demonstrates how the significant color contrast between dark basalt grains at the crests and light pumice between crests allows identification of megaripples in remote sensing data.*

We reintroduce the aeolian megaripples found in the Vikursundar, east/northeast of the Askja crater, Iceland (Fig. 1) as a Mars analog [8, 9, 10]. This environment is unique because of the cold climate, numerous surface processes interacting to shape the region's morphology and the katabatic (i.e., descending) winds forcing grain movement in volcaniclastic sediments [8]. Megaripples are located in numerous depressions between armored volcanic deposits and are downwind of a large deflationary basaltic sand sheet south of Askja described by [8, 11]. These megaripples were described by [9, 10] and later more completely characterized in the field by [8]. The megaripple fields are thought to have migrated via creep, reptation and saltation processes and resulted in positive sediment accumulation [8].

Methods: Gravel ripple migration is expected to be episodic and infrequent; therefore, precise measurement is required to detect changes from year to year. During field campaigns to study the Holuhraun eruption in 2015 and 2016 [12], a field site was selected to quantify surface changes, such as the position of megaripple crests and movement of individual grains of basalt and pumice components (Fig. 2). We collected ground-based photogrammetric, kite and unmanned aerial vehicle (UAV) aerial surveys that produced orthoimagery (<1 cm/pixel, Fig. 3) and digital terrain models of a megaripple field containing several bedforms. A differential global position positioning system (DGPS) ensured accurate georegistration of the data, and we have preliminarily coregistered orthoimagery to within 1 cm. We focused our study within the pumice fall deposit that blankets the Vikursundar region east-northeast of the Askja caldera. Satellite data from Worldview 3 (30 cm/pixel) were used to put the results of the ultrahigh spatial resolution topographic survey in a regional context, conduct a manual survey of megaripple crest orientation (n

= 4,340) and perform a supervised classification of multispectral image data to map surface facies and distinguish the deposits where megaripple fields occur (Fig. 1). After improvements have been made to orthoimage data, we see potential for the application of COSI-Corr [13] to detect subtle surface changes in grain distribution.

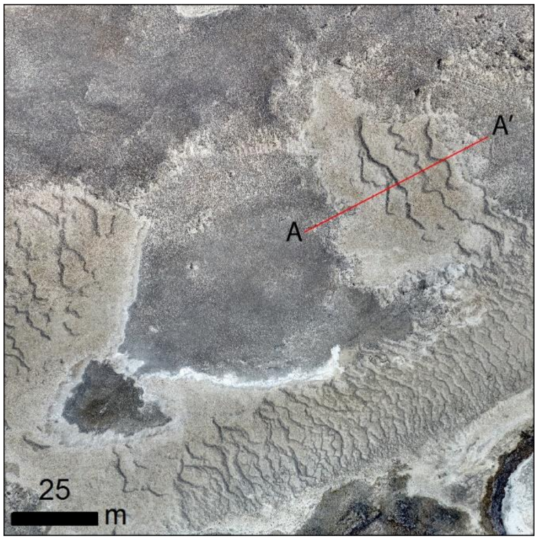

***Figure 3**: Orthoimage showing transverse and sinuous gravel megaripples. Light-colored sediments are dominated by pumice, where grey-colored areas are basaltic. Transect (A–A') shown in Fig. 4.*

Results and Discussion: Mapping of megaripple crests correspond well to the preliminary classification of pumice fall facies, and indicate a prevailing NE migration, consistent with [8]. Field photos taken in 2015 and 2016 are used to verify stoss and lee sides of megaripples, and in some cases, show windward erosion of mini-yardangs. The high fidelity of the kite (2015) and UAV (2016) aerial surveys allow observation of the displacement of individual basalt and pumice grains in the megaripple fields, indicating that these bedforms are probably active. However, the crests did not move between 2015 and 2016. A significant redistribution of pumice was observed between crests, but a prevailing direction has not yet been determined and sediment movement is thus far determined to be random. Dark bedforms were observed on dark pavement surfaces, which is an observation not previously reported and suggests that megaripples are not solely isolated to pumice-filled depressions. An extraction of topography shows a short megaripple train, indicating a large ripple with an amplitude of 40 cm and a spacing to the next crest of 10 m. This profile also suggests collision and merging between two megaripples at the beginning of the train. This type of morphological dynamics have been observed in barchan dunes [14]. Although the origin of these bedforms is clearly aeolian, we suggest that seasonal snowmelt plays an important role in sediment transport. Facies mapping of the area using the satellite and high resolution UAV data will determine superpositional relationships, infer bedform migration processes and elucidate megaripple formation processes.

References: [1] Bridges, N. T., et al. (2012) *Nature* 485(7398), 339–342. [2] Berman, D. et al. (2011) *Icarus* 213(1), 116–130. [3] Sullivan, R., et al. (2014) *LPSC XLV*, Abs. #1424. [4] Geissler, P. et al. (2014) *JGR Planets*, 119(12) 2583–2599. [5] de Silva S. L. et al. (2013) *Geol. Soc. Amer. Bull.*, 125(11–12), 1912–1929. [6] Foroutan, M. and Zimbelman, J. R. (2016) *Icarus*, 274, 99–105. [7] Hugenholtz, C. H. and Barchyn, T. E. (2016) *Icarus*, in press, 1-15. [8] Mountney N.P. et al. (2004) *Sed. Geology*, 166, 3, 223–244. [9] Greeley, R. and Peterfruend, A.R. (1981) *Geol. Soc. Amer.* 13(7), 463. [10] Edgett, K. et al. (1993) *J. Arid.*, 25, 3, 271–297. [11] Sara, M. J. et al. (2017), *LPSC XLVIII*, Abs. #2638. [12] Bonnefoy, L.E. et al. (2017), *LPSC XLVIII*, Abs. #1652. [13] Leprince, S., et al. (2007) *IGARSS 2007*, 1943–1946. [14] Scheidt, S. P. and Lancaster, N. (2013), *Earth Surf. Proc. Land.*, 38(9), 1005–1019.

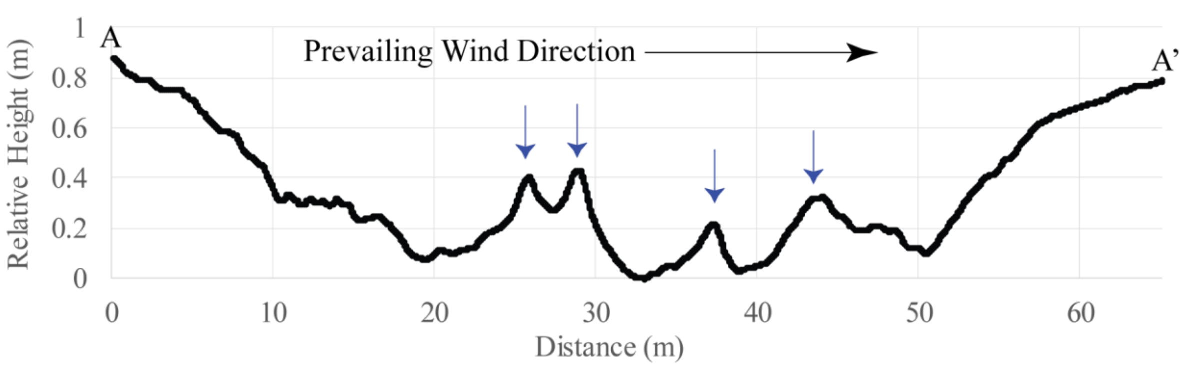

***Figure. 4**: Topographic profile (A–A' shown in plan view in Fig. 3) across a small depression containing a series of four pumice megaripples (ripple crests are indicated by blue arrows). The crest orientations indicate a net migration direction to the NE.*